The Geometers of God.

Mathematics in a Conservative Culture, Naples 1780-1840

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I declare that this thesis is my own work throughout. Some of the material has been already published as "The Geometers of God: Mathematics and Reaction in the Kingdom of Naples", *Isis*, 89: 674-701, with the approval of my supervisors.

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Abstract

The controversy about whether analytic or synthetic methods should be preferred for the solution of geometrical problems was common all over Europe, in the first half of the nineteenth century. It was related to important issues such as the definition of the new discipline of "pure mathematics", and it has been taken by recent historiography of science as an exemplary case for the analysis of conceptual change in mathematics. In this study, historical material relating to the under-researched case of Naples is presented, and used to support a new interpretation for the controversy. The study begins by describing the technical contents of the Neapolitan version of the controversy, referring to publications involved in one important, emblematic episode: the public challenge between the two rival geometrical schools, which took place in 1839. The competing methods are presented, and it is argued that, far from being caused by some mere "technical" divergence, the controversy arose from two very different conceptions of the nature and goals of geometry, and of mathematics in general. The following step is to look at the cultural environment where these two contrasting conceptions of mathematics were elaborated. Historical evidence supports the claim that both schools emerged in the very same period, the 1780s, and that the common interpretation of a preexisting synthetic school challenged by a new analytic school is misleading. Rather, the synthetic school emerged in reaction to the diffusion of analytic methods in Naples. It is also argued that the synthetic geometers were not simply "backward", and that they did not ignore the modern analytic methods; they chose to oppose the analytic conception of mathematics; they made the choice of being anachronistic. The wider philosophical and theological meaning of opposing the "spirit of analysis" is investigated, which brings us to the heart of the political and cultural upheaval which Naples experienced in the revolutionary and Napoleonic period. Two opposite networks of philosophers, ecclesiastics, scientists and literati emerge, one siding with the modernization of the country according to the French example, the other defending the semi-feudal structure of the Neapolitan state. It is only against the background of this crucial debate, over the re-shaping Neapolitan society, that the apparently detached controversy over geometrical methods is best understood. It is indeed argued that the production of scientific and mathematical knowledge, as that of any other form of knowledge, was shaped by the wider cultural and social goals of the actors involved. And, in fact, the controversy over geometrical methods, originally emerging in correspondence with the reaction to the French Revolution, eventually lost its scientific relevance in the early 1840s, as the cultural hegemony of Neapolitan reactionary forces declined. It is finally suggested that this sociohistorical interpretation of the Neapolitan case could cast light on other similar mathematical controversies of the first half of the nineteenth century.

Contents

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Chronological Table

1734	Establishment of the independent Kingdom of Naples, previously a Spanish Viceroyalty, and coronation of King Charles of the Bourbons	Reform of the University of Naples and foundation of the Academy of the Sciences. Mathematical teaching of Nicola and Pietro di Martino, who introduce Newtonian philosophy of nature in Naples, in opposition to traditional forms of dogmatic rationalism.
1759-1776	Moderate social and economic reformism of Prime Minister Bernardo Tanucci;	Anti-curial campaign of the Neapolitan Jansenist clergy, in defense of the rights of the Crown. Antonio Genovesi, from the chair of political economy, supports the implementation of an anti-feudal and a free-trade policy.
1780-1789	Intensification of reforms, particularly under Prime Minster Domenico Caracciolo (1786-89). The Bourbons tight their links with Austria, and follow the model of the "enlightened absolutism" of Joseph II Habsburg	High season of the Neapolitan enlightenment. The members of the school of Genovesi publish their crucial works on the reform of state and society. They ask for a liberal turn in policy, and for adopting the principle of *laisser-faire* in economics; i.e. for the abolition of the feudal-communal system of land.
1791-93	Anti-French policy, and political alliance with Rome and with Great Britain	Sudden change of attitude of the Bourbons with respect to the economic-political reforms, and to the anti-curial campaign: both are rejected for the sake of the new political alliance.
1794-98	Discovery of the Jacobin conspiracy, and political trials. War against France, and Neapolitan "liberation" of Rome from the French army. In December 1798, following the military collapse, the Bourbons flee Naples.	Isolation of the reformers, most of whom are arrested for being involved in the Jacobin conspiracy. 1796 year of the "crusade against culture". The Church is charged the entire system of public education. Neapolitan Jansenism is destroyed, and its exponents classified as "Jacobins".
1799	21-23 January, battle of Naples; meanwhile, on the 22, proclamation of the Republic of Naples by Neapolitan Jacobins. 29 January, anti-feudal laws. 13 June, the counter-revolutionary forces enter Naples. 23 June, capitulation of the besieged	Jacobin intellectual and former reformers are in power. Many Jansenist clergymen turn themselves into "Jacobin priests".

republicans.

1800-1806	"First" Bourbon restoration on the throne of Naples.	The personnel of the University of Naples is selected depending on political and "moral" considerations. Nicola Fergola and some members of his synthetic school of mathematics are offered prestigious positions. Fergola, together with the natural philosopher G.S.Poli, the anatomist D.Cotugno, and some ecclesiastics, re-organized public education in accordance with the principles of Reactionary Catholicism.
1806-1815	French occupation of the Kingdom of Naples. 1806 King Joseph Bonaparte 1808 King Joachim Murat	A number of exiles re-enter Naples. Flourishing of the late eighteenth-century philosophical tradition of Neapolitan sensationalism and *ideology*. In mathematics, the "analytic school" emerges, which is strongly critical of the synthetic research and teaching of Fergola and his followers.
1815-20	"Second" Bourbon restoration on the throne of Naples. Moderate policy of Prime Minister Luigi de'Medici, who avoid to repeat the violent repression of 1800.	Many intellectuals linked to the previous government remain in their places. But the Reactionary Catholic philosophy and the synthetic school of mathematics return to dominate the cultural panorama.
1821-1830	Pro-constitution insurrection, followed by nine months of "constitutional government" (1820-21). The liberals are eventually defeated and persecuted by the Bourbons, with the support of the Austrian army. It follows a blindly reactionary government.	Most of the philo-French intellectuals and reformers are exiled or arrested for their participation in the constitutional government. Reactionary Catholic apogee, in politics as in the cultural world. Flauti on the didactic of mathematics.
1830-1848	Ferdinando II new King of Naples	Slow decline of Reactionary Catholicism as a real political option and as cultural model. Steps in the direction of the "modernization" of the country are taken in the 1830s, not without strong resistance. In 1839: -the first Italian railway is completed (Naples-Portici); -the unification of the weights and measures of the kingdom is eventually approved; -the synthetic school of mathematics challenges the rival analytic school.

1848-49	Liberal forces in power. Ferdinando II is forced to accept a constitution, and a parliament begin to work in Naples.	The men of sciences linked to the analytic school, play a crucial role in the insurrection. Most of them fight in the anti-Austrian patriotic campaign.
1849-60	Return to order. In 1860, Giuseppe Garibaldi's military campaign in Southern Italy; defeat of the Bourbon army and annexation of the Kingdom of Naples to the new-born Kingdom of Italy.	Again, the normalization yield the expulsion of those who cooperated with the constitutional government. Member of the analytic school are still denied teaching posts in the University of Naples. This all change with the re-opening of the university, after the annexation to Italy.

Introduction

In 1839 a professor of mathematics at the Royal University of Naples challenged the members of a rival school to solve three geometric problems, in order to demonstrate to the Neapolitan public the superiority of the synthetic method over the analytic one. In 1839 Naples was connected to Portici via the first railway ever built in the Italian peninsula; it was only one of the remarkable achievements of the Neapolitan Corps of Engineers, who had been restructuring the viability of the kingdom. In 1839 an essay arguing for the possibility of miracles and containing a demonstration of the existence of God was published; it was a posthumous essay of the most famous Neapolitan mathematician of the period. In 1839 the debate over the opportunity of reforming the Neapolitan system of weights and measures entered its final and most lively phase. At the same time, the production of the landscape painters of the school of Posillipo, who had dominated the artistic panorama of the Restoration, seemed to have lost its unitary character; their idyllic representations of Neapolitan countryside were giving way to new forms of naturalism and realism. These episodes (like many others which took place at the sunset of the Restoration age) were rooted in the cultural atmosphere of the turn of the century. In many respects, they were the concluding episodes of an intense political and cultural period, which had seen a Jacobin revolution (1799), the French occupation (1806-1815), a liberal insurrection followed by a brief constitutional government (1820-21), a decidedly reactionary policy (after 1821), and the difficult implementation of a series of administrative and economic reforms (1830-1839)[1]. One way of looking at this part of Neapolitan history, and a fruitful way I believe, is to recognize, as a fundamental leitmotiv, that of the struggle for the "modernization" of the country. By the term "modernization" I shall mean, quite straightforwardly, the complex historical process of transformation of the Neapolitan state, society and landscape from an *ancien régime* structure to that of a centralized, administrative monarchy and of a liberal economy. The process had begun in the late eighteenth century, it had suddenly increased its speed during the French government, and it continued, though more slowly, in the Restoration age. Telling the story of the 1839 mathematical contest —as it would be for the story of the first railway, or of the Posillipo school of landscape painting— is then also a way to tell the story of the struggle which tore apart Neapolitan society in the course of the process of modernization.

Historians of science have pointed out that the four decades around 1800 were a crucial period for the definition of many modern scientific disciplines and for their institutionalization. Boundaries were drawn between legitimate and illegitimate methodologies and between the different fields of investigation, while curricula of higher education were re-designed or created *ex novo*. This was also the period when the figure of the professional researcher achieved a precise and recognized social status, in the context of the new administrative structures of the modern state. Indeed, one result of the processes of modernization which arose —or increased their speed— in a number of European countries since the French Revolution and the Napoleonic wars, was precisely the creation of new figures of full-time researchers, and the establishment of new scientific institutions of teaching and research. It has been argued that the study of these figures and of these institutions is indeed essential to understand the changes in the practice and in the cognitive contents of the sciences[2]. Similarly, the present study aims to be a contribution to the general understanding of the nature of the cultural and scientific changes which took place at the turn of the nineteenth century, even though attention will be directed towards a rather different kind of explanatory factors.

The focus of the present study is a controversy which was particularly lively among the mathematicians of the town of Naples between the 1780s and the 1830s, regarding problem-solving methods in geometry. We will see how this specific debate was in fact related to other relevant scientific and philosophical issues; nevertheless, this study begins and ends up with the practice of solving geometrical problems. In other words, a choice has been made in this reconstruction to keep a specific form of knowledge, mathematics, in the forefront, other forms remaining in the background. The question remains of why mathematics is in the forefront and not, says, medicine or landscape painting, which would also offer extremely interesting material to the sociologist of knowledge[3]. Quite simply, mathematical sciences have not enjoyed the same degree of attention and have not seen the same flourishing of sociohistorical studies which has characterized other branches of the sciences, or even landscape painting[4]. Although for mathematics the years around

1800 signalled a fundamental shift in practice as well as in conceptualization, the sociohistorical studies devoted to them are still not enough to provide ground for generalization, and they are limited to a few cases from Prussia, England and France[5]. Much more historical material is needed then, particularly from other countries, in order to deepen our understanding of the causes and modalities of changes in mathematical knowledge around 1800. The lack of such historical material, together with the persistence of certain philosophical assumptions about the nature of mathematics as essentially different from any other form of knowledge, has permitted the long-lasting predominance of a cumulative and teleologically oriented account of the development of mathematical knowledge. As a result, it is only recently that some authors in the history of mathematics have promoted a general re-orientation of their field, which included the redefinition of their own analytic instruments and of their general assumptions[6]. With respect to these issues, which are still objects of debate, the present study aims to show the shortcomings of the traditional, cumulative approach in the specific case under study, and to show how considerations from social and cultural history can be fruitfully integrated with the traditional tools of the historiography of mathematics.

The protagonists of the Neapolitan controversy were members of two schools of mathematics, who grounded their teaching and research upon two different sets of problem-solving techniques. The controversy was centered on geometrical problem-solving but, by looking at the writings of the actors, one sees that disagreement extended to every other branch of mathematics as well. Indeed, while debating about such "technical" issues as which is the most proper way to solve geometrical problems, the actors were also defending certain specific assumptions about the nature of mathematics, and attacking others. Among these assumptions were those relative to the goals of mathematics, of its basic values, and of the relation between mathematical knowledge and empirical reality. So, for instance, the criteria employed to judge the validity of the proof of a theorem, of the solution of a problem, or of their "elegance" were far from being agreed upon, and they were in fact objects of intense debate. In other words, the controversy involved fundamental metamathematical beliefs of the actors, as well as their mathematical practices. Given this, there are at least two kind of considerations which should be born in mind when placing the Neapolitan controversy in the European context.

a) First of all the controversy was an instance of the widespread opposition between supporters of purely synthetic geometry and supporters of purely analytic geometry. During the eighteenth century pure geometrical methods had survived as a marginal discipline, overshadowed by the success of algebraic and analytic methods applied to geometry. Pure geometry and its synthetic methods were cultivated with passion in cultural areas which remained at the margins of the great development of analysis, such as England and Scotland, where Colin Maclaurin (1698-1746), one of the most famous synthetic geometers of the first half of the century, worked. Nevertheless, particularly in France, in the German countries and in the areas which were subject to their cultural influence, pure geometry suffered a generalized and deep decline, as the "analytic spirit" extended its empire to the solution of geometrical problems as well. The application of algebra and calculus to geometry had in fact transformed the practice of this science. While apparently tackling the same problems as their predecessors, analytic geometers of the eighteenth century were acting and thinking in a very different way. To most of the famous and extremely productive analysts —such as Euler, d'Alembert, the Bernoullis and Lagrange— "analysis", in its wider sense, was a set of algebraic technique, both finite and infinitesimal, which could be applied to solve problems from the most diverse fields of experience. Geometry was seen as just another possible field of application of analytic reasoning, which they regarded as valid and legitimate in itself, whatever was the object under study[7]. And also in the case of geometry the analytic procedures had demonstrated their enormous heuristic power, offering solutions of unprecedented generality, and accomplishing a remarkable homogenization and mechanization of problem-solving procedures. Lagrange's memoir on triangular pyramids (1773) was emblematic of the purely analytic approach to geometry, and it also signalled its point of highest refinement[8]. As a matter of fact Lagrange had managed, in this memoir, to eliminate geometrical figures as sources of intuitive knowledge, to generalize its considerations about the properties of pyramids at the highest level, and to reduce geometrical problem-solving to a question of mechanic procedures. It was in reaction to the diffusion of the Lagrangian approach to geometry that, since the 1820s, a number of geometers planned to rescue the classical synthetic methods from oblivion, and to develop them to compete with the generality and fruitfulness of the modern analytic methods. Quite traditionally, Morris Kline describes this new geometrical program of the early nineteenth century as due to a number of geometers who had eventually realized that the abandon of synthetic geometry had been unjust and imprudent[9]. Opposition to purely analytic methods emerged precisely in France and Germany, where the analytic spirit had been dominating mathematical teaching and research for decades. In France, this reaction came primarily from a group of geometers who had studied with Gaspard Monge (1746-1818) at the *École Polytechnique* between 1795 and 1809. Following Monge's teaching, they developed the new branch of descriptive geometry, but they also revived the tradition of Euclidean geometry. It should be noted though, that while Monge had been recovering synthetic methods in the framework of his research in analytic and differential geometry, some of his pupils, such as Lazare Carnot (1753-1823), Jean-Baptiste Biot (1774-1862), Jean-Victor Poncelet (1788-1867), joined later by Michel Chasles (1793-1880), aimed to completely restore the "dignity" of synthetic geometry, and to improve its techniques whilst being respectful of the spirit of the Greek tradition, i.e. without betraying the proper "nature" of geometry. Their program was designed in explicit opposition to the analytic approach; they remarked that its great generality and its heuristic insights were obtained at too high a price: the abandoning of the study of the particular figure, i.e. the only source of intuitive geometrical knowledge. How can one be sure that the algebraic solution of a geometrical problem is valid, if it is only grounded and legitimated by algebraic reasoning? If one assumes that the meaning of geometrical propositions can only be derived from the intuitive knowledge obtained from the inspection of the figure, than the formal transformations of analysis appear to be "blind" steps, whose final result shows no clear connections with the initial geometrical conditions of the problem. So Chasles could oppose to the fast and general procedure of analysis the step-by-step procedure of synthesis, noting how each passage of the latter method is immediately justifiable by reference to the figure, while the geometrical meaning of the passages of the former method remains obscure[10]. This sort of argument was related to specific epistemological assumptions about the nature of mathematics held by the synthetic geometers; so that while geometry was thought of as a science grounded on intuitive knowledge of "real" truths, algebra and analysis were conceived as "artificial" methods useful to suggest the truth about certain geometrical questions, but lacking of proper meaning and legitimacy. Indeed, supporters of synthetic methods stressed the lack of rigor of analytic procedures, and the need to provide a sound basis for the calculus, i.e. those "foundational" problems which emerged precisely at the beginning of the nineteenth century. Emblematic of the French controversy between synthetics and analytics was the controversy between Poncelet and Joseph-Diaz Gergonne (1771-1859), founder and director of the prestigious journal *Annales de Mathématiques*, and a well-known cultivator of purely analytic geometry. The French controversy had echoes in the German countries, where a school of synthetic geometers grouped around Jacob Steiner (1796-1863), who was to became professor in the new university of Berlin, and who was protagonist of the controversy with his fellow-countryman Julius Plücker (1801-1868), professor of physics and supporter of the algebraic approach to descriptive geometry. With respect to these controversies, the Neapolitan case is a rather early phenomenon, as the Neapolitan program to rescue the Greek style of geometrizing dates to the mid-1780s. In fact, the possibility has been raised of whether Neapolitan texts bought by French officers in the 1780s could have somehow stimulated the French debate[11]. There are no historical grounds to support such an hypothesis and, anyway, I believe this is not a particularly meaningful point. Note instead how, in the rapidly changing institutional situation of the beginning of the nineteenth century, the restoration of pure geometry emerged as an issue in those states where the analytic tradition had been until then predominant.

b) On a more general level, the controversy analyzed in this study can be seen as representative of the crucial transition from the tradition of eighteenth century analysis to the new discipline of "pure mathematics". It has been observed that between the 1780s and the 1820s mathematical practice, which had remained relatively stable and homogeneous in its goals and methods for a few decades, underwent important technical and epistemological changes. These have been stressed in some historical studies, which provide material to contrast the traditional and persistent description of this period as that of the "rigorization of calculus", implying that the advancements of the eighteenth century analysis were finally (and rightly) perceived as lacking a sound logical basis. The risk of making anachronistic claims is extremely high in cases like this, where one also tends to assume that pieces of knowledge such as specific mathematical problems somehow preserve a stable meaning through the decades and through the centuries, independently of the changing practice and the changing metamathematical beliefs of the actors who try to solve them. And indeed the case of the rigorization of calculus is emblematic of the presence of anachronistic assumptions and of the "illusion of persistence" in much historiography of mathematics. In short, what I am calling the traditional historiography presents the process of rigorization of the calculus a necessary outcome of the great (but "illogical"[12]) expansion of eighteenth century analysis: there *were* logical and foundational shortcomings in the practice of eighteenth century analysts, and they were finally addressed by Lagrange (in his last period) and, in the 1820s, by Cauchy, Abel, Jacobi and many others. According to this interpretation, the changes in the practice of mathematics which are usually associated with the rigorization of the calculus, and the new role played by pure mathematics as founding discipline, are explainable in terms of a progressive refinement of the theory of the calculus. It is as if the focus had moved, at some point around 1800, from empirical applications to issues relative to logical foundations and internal consistency. A very different view is held by the authors of those sociohistorical studies, where the perception of the calculus as lacking sound foundations, and the legitimization of new mathematical techniques specifically elaborated to address foundational issues, are seen in connection with changes in the institutional situation of mathematics, and in the role and duties of teachers and researchers. So, for instance, it has been convincingly shown that, in the case of Prussia, the fact that "pure mathematics" gained authority and legitimization as a founding discipline, cannot be understood without referring to the process of professionalisation of research which took place within the reform of education of the early 1800, and to the newly introduced "imperative of research"[13]. In this context, foundational and "internal" issues emerged suddenly as the new and exclusive field of work of the Prussian university professor-researcher, whose figure was defined in opposition to that of the applied mathematician, or the engineer. Another case which has provided interesting material is that of the university of Cambridge, where in the 1820s an analytic school was created which pressed for the introduction of continental analysis in England, and emphasized the study of mathematics *per se*, as a pure and autonomously legitimated discipline. In this case, it has been showed how the emergence of pure mathematics was connected to a contemporary re-definition of the role of mathematics in the students' curricula, and particularly to its being used as an instrument for ranking and selecting students[14]. The present study aims to add another historical case where the stress on "pure mathematics" can be seen as essentially connected to certain cultural and institutional changes, even though of a rather different nature.

A few words must be said about why the case of Naples has been chosen. Naples, capital of an ancient Spanish viceroyalty, and since 1734 of an independent kingdom, presents the historian with very peculiar sociopolitical features. In fact, one could hardly think of an institutional and social situation which was further from the Prussian or the English one. This makes the investigation of Neapolitan controversy particularly interesting, as confronting its dynamics with those of the cases cited above should allow us to see if there is any relevant common feature, and also to compare the way in which the social context acted upon the production of scientific knowledge. The case of Naples can be contrasted with those already studied, and from which generalizations have already been made. In addition, the case of Naples allows us to study of the causal role of social conditions upon scientific knowledge. This is because European mathematicians of the early nineteenth century referred primarily to a corpus of works which was relatively homogeneous, and included the work of the great eighteenth century analysts, plus the Greek geometrical tradition. The presence of different social conditions, at the macro-level as well as the level of institutions of higher education, provides the opportunity to study the way in which the same corpus of knowledge can be differently selected, adopted and developed in the light of different goals.

In this respect, the present study aims to contribute to that well-established tradition of social history of science which refers primarily to the theoretical works of the sociology of scientific knowledge (ssk)[15]. In fact, this study is informed by current concerns in ssk, and among its purposes is that of strengthening the historiographic value of the causal connection between socio-cultural conditions and the production of scientific knowledge. In particular, the hypothesis will be tested that the political and cultural reaction which characterized Neapolitan life in the Restoration age shaped the production of mathematical knowledge. Scientific and mathematical knowledge produced by a specific group of Neapolitan scientists is best understood when placed in the context of the Neapolitan conservative thought. "Conservative thought" usually refers to a loosely connected body of writings whose purpose is broadly to conserve aspects of culture and society from radical change or disruption[16]. Conservative thought has been studied in its relations to sociology[17], history[18], and literature[19]; in its opposition to certainty and the spirit of system[20]; in its relations to civility and politeness[21]; to cognitive pluralism[22], to culture and custom[23], to tacit knowledge[24]. In this study we shall consider a particular form of conservative thought, labeled by historians as "Reactionary Catholicism"[25]. The term "Reactionary Catholic thought" will be employed, its meaning being restricted to those aspects which are common to the writings of intransigent Catholic authors (mostly Italian and French) who attacked the social and political outcome of the Enlightenment and of the French Revolution in the early nineteenth century. This specific form of conservative thought will be described in its relation to scientific and mathematical knowledge. The relation between forms of conservative thought and scientific knowledge has been scarcely researched, which is rather surprising considering the crucial role modern science played in the very definition and in the early debates between conservative authors and their liberal opponents. (In fact, even authors far from the practice of science, such as Joseph de Maistre, wrote repeatedly on the nature of scientific knowledge)[26].

The present study adopts the following structure. In the first part (**Chapter one**) the controversy over geometrical methods, and its links with more general assumptions about the nature of mathematics, are introduced. The historical reconstruction of the controversy, to which very limited attention had been paid by historians of science, is centered around an emblematic episode: the 1839 public challenge between the champions of the synthetic school and those of the analytic school. Nevertheless examples and quotations have been chosen also from other texts, so to provide an overview of the contents of the entire controversy. This part is concluded by remarking how the methodological controversy cannot be properly assessed without referring to the epistemological assumptions of the actors. The second part (**Chapters two and three**) is devoted to illustrating some features of the philosophical and social thought of the Neapolitan Enlightenment, and its links with a specific political project. It is also shown how the "analytic style of thought" was imported into Naples to be employed as a powerful cultural resource to defend certain specific cultural and political positions. In particular, an attempt is made to reconstruct the political and scientific thought of those linked to the Neapolitan Jacobin movement of the early 1790s. The importance is stressed of not detaching their scientific (and particularly mathematical) conceptions from their political project. An intuitive notion of the "structure of knowledge" is employed to make sense of a crucial epistemological shift employed by Neapolitan reformers and Jacobins with respect to traditional Neapolitan culture. From this part of the study the connection between certain philosophical and political programs and the practice of the analytic mathematicians should emerge. The third part (**Chapters four and five**) offers a reconstruction of Reactionary Catholic thought, as it emerged in Italy and France since the 1790s. Given the lack of reliable references in this field, and particularly of studies concerning the epistemological implications of this doctrine, the space devoted to this part has necessarily been extensive. This is justified by the connection established between Reactionary Catholicism and the practice of mathematics of the synthetic school. The possibility of investigating the interactions between Reactionary Catholicism and other forms of scientific research (such as medicine and experimental physics) is also suggested. Finally (**Chapter six and seven**), the story of the controversy is reconstructed, from the beginning in the 1780s to its "closure" in the 1840s. The narration aims to show the links between the many "histories" which make up this case-study. This means showing that the story of the controversy over geometrical methods cannot be told without telling the stories of the political, social, and cultural changes which took place in Naples between the 1780s and the 1830s.

Notes to the introduction

[1] For an introduction to the political and social history of the Kingdom of Naples between the eighteenth and nineteenth centuries see Angelantonio Spagnoletti, *Storia del Regno delle Due Sicilie* (Bologna: Mulino, 1997). On the 1799 revolution and the Restoration age see the classic Vincenzo Cuoco, *Saggio storico sulla rivoluzione napoletana del 1799, seguito dal rapporto al cittadino Carnot di Francesco Lomonaco* (Bari: 1913; orig.ed. 1801); and Benedetto Croce, *La rivoluzione napoletana del 1799* (Bari: Laterza, 1953). See also Pasquale Villani, *Mezzogiorno tra riforme e rivoluzione* (Bari: Laterza, 1962); and Gaetano Cingari, *Mezzogiorno e Risorgimento. La Restaurazione a Napoli dal 1821 al 1830* (Bari: Laterza, 1970). On the political life of the Neapolitan Republic see Mario Battaglini, *La Repubblica Napoletana. Origini, nascita, struttura* (Rome: Bonacci, 1992). On the administrative reforms of the French government and their

social meaning see the very detailed Armando de Martino, *La nascita delle intendenze. Problemi dell'amministrazione periferica nel Regno di Napoli 1806-1815* (Naples: Jovene, 1990); and Anna Maria Rao and Pasquale Villani, *Napoli 1799-1815. Dalla repubblica alla monarchia amministrativa* (Naples: Edizioni del Sole, 1995).

[2] See the studies in Hans Jahnke and Michael Otte, *Epistemological and Social Problems of the Sciences in the Early Nineteenth Century* (Dordrecht: Reidel, 1981).

[3] The 1820s saw the emergence of the highly original school of landscape painting known as "school of Posillipo"; see Luisa Martorelli, *Giacinto Gigante e la scuola di Posillipo* (Naples: Electa, 1993). The ideological dimension of this way of representing Neapolitan rural landscape has been pointed out in Massimo Mazzotti, "Campania Felix: On Representation of Neapolitan Landscape in the Early Nineteenth Century", manuscript.

[4] Early works in this field were: John Barrell, *The Dark Side of Landscape: The Rural Poor in English Painting, 1730-1840* (Cambridge: Cambridge U.P., 1980); and David Solkin, *Richard Wilson: The Landscape of Reaction* (London: Tate Gallery, 1982).

[5] Among the sociohistorical studies on the transformation of mathematics at the turn of the nineteenth century are the works by Judith Grabiner: *The Origins of Cauchy's Rigorous Calculus* (Boston: MIT Press, 1981) and *The Calculus as Algebra. J.-L. Lagrange, 1736-1813* (New York: Garland, 1990). See also Winfried Scharlau, "The Origins of Pure Mathematics", in Hanke-Otte, *Epistemological and Social Problems*, pp.331-348; Ivor Grattan-Guinness, "Mathematical Physics in France, 1800-1835", ibidem, pp.349-370; Joseph Dauben, "Mathematics in Germany and France in the Early 19th Century: Transmission and Transformation", ibidem, pp.371-400; Gert Schubring, "Changing Cultural and Epistemological Views on Mathematics and Different Institutional Contexts in Nineteenth Century Europe", in Catherine Goldstein, Jeremy Gray, and Jim Ritter, *Mathematical Europe. History, Myth, Identity* (Paris: Éditions de la maison des sciences de l'homme, 1996) pp.363-390; and the contributions to Henk Bos, Herbert Mehrtens, and Ivo Schneider (eds.), *Social History of Nineteenth Century Mathematics* (Boston: Birkhäuser, 1981). A recent study on the case of Cambridge is Andrew Warwick, "Exercising the Student Body: Mathematics and athleticism in Victorian Cambridge", in Christopher Lawrence and Steven Shapin (eds.) *Science Incarnate* (Chicago: Chicago U.P., 1998) pp.288-326.

[6] A pioneering work in the social history of mathematics was Henk Bos and Herbert Mehrtens, "The Interactions of Mathematics and Society in History: Some Exploratory Remarks", *Historia Mathematica*, 1977, 4:7-30. See also the studies in Bos, Mehrtens, and Schneider (eds.), *Social History of Nineteenth-Century Mathematics*; and Donald MacKenzie, *Statistics in Britain, 1865-1930: the Social Construction of Scientific Knowledge* (Edinburgh, Edinburgh U.P., 1981); Joan Richards, *Mathematical Visions: The Pursuit of Geometry in Victorian England* (San Diego: Academic, 1988); Steven Shapin, "Robert Boyle and Mathematics: Reality, Representation and Experimental Practice", *Science in Context*, 1988, 2:23-58; Mario Biagioli, "The Social Status of Italian Mathematicians, 1450-1600", *History of Science*, 1989, 27:41-69; and Mehrtens, *Moderne-Sprache-Mathematik: Eine Geschichte des Streits um die Grundlagen der Disziplin und des Subjekts formaler Systeme* (Frankfurt am Main: Suhrkamp, 1990). For an overview of both the social history of mathematics and recent empiricist trends in philosophy of mathematics see Joan Richards, "The History of Mathematics and *L'esprit humain*: A Critical Reappraisal", *Osiris*, 1995, 10:122-135. For the early modern period see Paolo Mancosu, "Literature Survey: Recent Publications in the History and Philosophy of Mathematics from the Renaissance to Berkeley", *Metascience*, 1999, 8:102-124.

[7] On the history of analysis in the eighteenth and nineteenth centuries see Ivor Grattan-Guiness, *The Development of the Foundations of Mathematical Analysis from Euler to Riemann* (Boston: MIT Press, 1970) and Umberto Bottazzini, *Il calcolo sublime. Storia dell'analisi matematica da Euler a Weierstrass* (Turin: Boringhieri, 1981). On the eighteenth century see Henk Bos, "Calculus in the Eighteenth Century: The Role of Applications", *Bulletin of the Institute of Mathematics and Its Applications*, 1977, 13:221-227; and Craig Fraser, "The Calculus as Algebraic Analysis: Some Observations on Mathematical Analysis in the Eighteenth Century", *Archive for the History of Exact Sciences*, 1989, 39:317-336. On methods in geometry

see Julian Coolidge, *A History of Geometrical Methods* (New York: Dover, 1963); and Carl Boyer, *History of Analytic Geometry* (New York: Scripta Mathematica, 1956).

[8] Joseph-Luis Lagrange, "Solutions analytiques de quelques problèmes sur les pyramides triangulares" (1773), in *Oeuvres de Lagrange*, edited by J.A.Serret, vol.3 (Paris: 1869), pp.661-692.

[9] Morris Kline, *Mathematical Thought from Ancient to Modern Times* (New York: Oxford U.P., 1972) see chapter 35.

[10] This is the general perspective adopted by Michel Chasles, *Aperçu historique sur l'origine et le développement des méthodes en géométrie* (Paris: 1875; orig.ed. 1837).

[11] See Federico Amodeo, *Vita matematica napoletana*, vol.1 (Naples: 1905) p.144.

[12] "The illogical development" is how Kline famously defined the elaboration of eighteenth-century calculus; see Morris Kline, *Mathematics: The Loss of certainty* (New York: Oxford U.P., 1980) chapters five to eight.

[13] Gert Schubring, "The Conception of Pure Mathematics as an Instrument in the Professionalization of Mathematics", in Bos-Mehrtens-Schneider, *Social History of Nineteenth-Century Mathematics*, pp.111-134; see also Stephen Turner, "The Prussian Professoriate and the Research Imperative, 1790-1840", in Jahnke-Otte, *Epistemological and Social Problems of the Sciences in Early Nineteenth Century*, pp.109-122.

[14] See Philip Enros, "Cambridge University and the Adoption of Analytics in early Nineteenth Century England", in Bos-Mehrtens-Schneider, *Social History of Nineteenth Century Mathematics*, pp.135-148; and Warwick, "Exercising the Student Body".

[15] The ssk studies the social variables of scientific knowledge. Unlike earlier programs in the sociology of science (e.g. those by Mannheim or Merton), ssk is based on the assumption that all knowledge has social variables, including mathematical and logical knowledge. This assumption is usually referred to as "the strong program in the sociology of scientific knowledge" (see David Bloor, *Knowledge and Social Imagery* (London: Routledge, 1976)). Much of the methodology, philosophical foundations, and results of ssk has been formulated by present and former members of the Science Studies Unit of the University of Edinburgh. See David Bloor, "Two Paradigms for Scientific Knowledge", *Science Studies*, 1971, 1:101-115; David Bloor, *Wittgenstein: A Social Theory of Knowledge* (New York: Columbia U.P., 1983); David Bloor, *Wittgenstein: Rules and Institutions* (London: Routledge, 1997); Barry Barnes, *Scientific Knowledge and Sociological Theory* (London: Routledge, 1974); Barry Barnes, *Interests and the Growth of Knowledge* (London: Routledge, 1977); Barry Barnes, *Thomas Kuhn and Social Science* (London: Macmillian, 1982); MacKenzie, *Statistics in Britain, 1865-1930*; Donald Mackenzie, "Slaying the Kraken: The Sociohistory of a Mathematical Proof", *Social Studies of Science*, 1999, 29:7-60; Steven Shapin and Simon Schaffer, *Leviathan and the Air Pump. Hobbes, Boyle, and the Expeimental Life* (Princeton: Princeton U.P., 1985).

[16] See Roger Scruton (ed.), *Conservative Texts. An Anthology* (London: Macmillan 1991).

[17] See, for instance, Robert Nisbett, *The Sociological Tradition* (New York: Basic Books, 1966) pp.3-18; Robert Nisbett, *Conservatism: Dream and Reality* (Milton Keynes: Open U.P., 1986); and Roger Scruton, *The Meaning of Conservatism* (London: Macmillan, 1984).

[18] See, for instance, Karl Mannheim, "Conservative Thought", in Karl Mannheim, *Essays on Sociology and Social Psychology* (New York: Oxford U.P., 1953) pp.74-164; and John Weiss, *Conservatism in Europe 1770-1945: Traditionalism, Reaction and Counter-Revolution* (London: Thames and Hudson, 1977).

[19] See, for instance, Philip Thody, *The Conservative Imagination* (New York: St.Martin Press, 1993).

[20] See, for instance, David Bloor, "Wittgenstein as Conservative Thinker", manuscript; and Michael Oakeshott, *Rationalism in Politics and Other Essays* (Indianapolis: Liberty Fund, 1991).

[21] See, for instance, Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: Chicago U.P., 1994) chapters one to three.

[22] See, for instance, Michale Oakeshott, *Experience and Its Modes* (Cambridge: Cambridge U.P., 1991) particularly chapters one and two.

[23] See, for instance, Shapin, *A Social History of Truth*, chapters two and three; and Roger Scruton, *The Politics of Culture and Other Essays* (Manchester: Carcanet Press, 1981).

[24] See, for instance, Michael Polanyi, *Knowing and Being* (Chicago: Chicago U.P., 1969) chapters eight to twelve; and Stephen Turner, *The Social Theory of Practices: Tradition, Tacit Knowledge and Presuppositions* (Chicago: Chicago U.P., 1994).

[25] See Luigi Salvatorelli, *Il pensiero politico italiano dal 1700 al 1870* (Turin: Einaudi, 1975) chapters five and six.

[26] The relation between conservative thought and scientific knowledge has been treated in William Coleman, "Bateson and Chromosomes: Conservative Thought in Science", *Centaurus*, 1970, 15:228-314; David Bloor, "Two Paradigms for Scientific Knowledge"; Bloor, *Knowledge and Social Imagery*; Jonathan Harwood, "The Race-Intelligence Controversy: A Sociological Approach. I-Professional Factors", *Social Studies of Science*, 1976, 6:369-394, and "II-External Factors", ibidem, 1977, 7:1-30; Jonathan Harwood, *Styles of Scientific Thought: The German Genetic Community 1900-1933* (Chicago: Chicago U.P., 1993); Mackenzie, *Statistics in Britain*; David Smith and Malcom Nicolson, "The Glasgow School of Paton, Findlay and Cathcart: Conservative Thought in Chemical Physiology, Nutrition and Public Health", *Social Studies of Science*, 1989, 19:195-238. See also Friedrich von Ayer, *The Counter-Revolution in Science. Studies in the Abuse of Reason* (Indianapolis: Liberty Fund, 1979). The literature on scientific and technological knowledge under the Nazi regime is particularly rich; see Jeffrey Herf, *Reactionary Modernism: Technology, Culture and Politics in Weimar and the Third Reich* (Cambridge: Cambridge U.P., 1984); for bibliographical references, see Mitchell Ash, "Science, Technology, and Higher Education under Nazism", *Isis*, 1995, 86:458-462; and Teresa Hopper, "Recent Books on Nazism and Science", *Historical Studies in the Physical and Biological Sciences*, 1996, 27:163-176.

Chapter One

Solving Geometrical Problems: Sublime Art or Mechanical Procedure ?

In the first part of this study the specific techniques adopted by two competing mathematical schools to solve geometrical problems are described. The protagonists of this a controversy were, on the one side, the members of the "synthetic school", who defended purely geometrical methods; on the other, those of the "analytic school", who promoted a purely algebraic approach to geometry. The choice between one or the other method —both in research and didactically— emerged as a scientific and philosophical concern after 1780, and the controversy remained lively until the late 1830s, when it suddenly lost its scientific significance.

Debates between supporters of purely geometrical methods and those of purely algebraic methods were not uncommon in early nineteenth century Europe. The question was: which of the two methods is the most appropriate to solve geometrical problems? Many of those who raised this question were interested in both research and teaching; in their eyes one or the other method should be decidedly preferred in order both to find new geometrical truths and to present such truths to the pupils. Previous geometers had found it useful to mix the methods in their practice, so that, for instance, synthetic methods were largely used in teaching elementary geometry because of their exemplary rigour and clarity, whereas algebraic methods were used in research because of their renowned heuristic power. This is not the case with the geometers who debated the value of the two methods in the first half of the nineteenth century, and certainly this was not the case with Neapolitan geometers. In their eyes one of the two methods should enjoy some kind of priority which was both epistemological and ontological. This is hardly obvious to a contemporary reader: indeed, from a twentieth-century point of view, which is characterised by a structural and (modern) axiomatic conception of mathematical theories, the question of such a priority makes no sense. In other words, we cannot easily see why Neapolitan geometers considered such styles of mathematical reasoning as exclusive alternatives. My suggestion is that, in order to cast light on the reasons for this geometrical controversy, it is necessary to refer to the more general conception of mathematics held by the actors themselves. Indeed, the meaning of terms such as "certainty", "validity", "elegance", "reliability", "efficiency", "utility", which are crucial to the debate, is far from being straightforward. And in fact, the disagreement between Neapolitan geometers involved the very definition of these terms, so that even when discussing some apparently well-defined technical point, geometers from the two schools were actually at great conceptual distance. In the following, we shall try not to translate problems and goals of Neapolitan mathematicians in our own contemporary language: this would imply overlooking crucial meaning-shifts of both terms and problems. Rather, we shall try to reconstruct the original meanings of mathematical terms together with their own original conceptual framework and the practice in which they were used. That is to say, we shall offer an interpretation of the controversy, linking the technical divergence to different beliefs about the nature of mathematics. The risks connected with such interpretations are by far preferable to the risk of falling victim to what we call the illusion of the "stability of problems", which consists in presenting the history of mathematics as characterised by the presence of a number of more or less general questions which are differently tackled by different generations of mathematicians, until they are eventually "solved", "better solved" or discarded because "unsolvable". The latter historiographic perspective rests on a fundamental teleological assumption, according to which mathematics has been necessarily evolving in a certain direction (towards our own contemporary mathematics), which can be assumed as a privileged point of view for describing the production of every previous piece of mathematical knowledge. This study is based on the rejection of such teleological assumption about the history of mathematics, and does not assume that there is some necessary inner logic guiding the historical development of mathematical knowledge. This means assuming that every problem is essentially "unstable", its meaning being the object of continuous re-negotiation. Coming back to the Neapolitan controversy, this means looking for an interpretation which does not simply refer to previous (or later) conceptions of analysis and synthesis. The Neapolitan case is not seen merely as a step in the long-term intellectual debate between, say, synthetic-minded and analytic-minded geometers. Rather, it is by looking at history, and through the historical reconstruction of the mathematical practice and of the beliefs of the actors, that a plausible interpretation of the controversy will be constructed.

1.1 Introductory Remarks

The summer of 1839 saw what was probably the last mathematical *disfida* (challenge) which took place in the Italian peninsula[1]. The glorious tradition of Renaissance *disfide* seems to have ended with this rather obscure episode, which occurred in the capital of one of the most conservative kingdoms in Europe, the Kingdom of Naples[2]. The Neapolitan case is worthy of particular attention because in Naples the debate over methods assumed very harsh tones, and it shaped the local mathematical production for decades. The 1839 challenge was in fact one of the last noteworthy episodes in the fifty-year old debate between the "synthetic school" of geometry (usually defined as *the* Neapolitan school *tout court*, because of its predominant position) and its analytic opponents.

At the core of the controversy was the research and teaching of Nicola Fergola (1752-1824), the most influential and celebrated Neapolitan mathematician of his generation. A private teacher of mathematics and philosophy since the 1770s, Fergola was appointed professor at the Royal University of Naples (RUN) in 1789; since then, his influence on the practice of the mathematical sciences in Naples remained almost uncontested for around thirty years, which were the golden age of the synthetic school of Naples. Under Fergola's guidance, young students discovered the geometrical works of the ancients, and they were shown those criteria of clarity, elegance and rigour which should inform their own activity as teachers and practitioners of mathematics. Among Fergola's pupils were abbé Felice Giannattasio (1759-1849), Annibale Giordano (1769-1836), Giuseppe Sangro (ca.1775-1835), Giuseppe Scorza (1781-1843), Francesco Bruno (ca.1790-1862), Vincenzo Flauti (1782-1863), Ferdinando De Luca (1783-1869), and many more. They made up most of early nineteenth century Neapolitan mathematics. Fergola's teaching ability was renowned in Naples, and his lectures were crowded with students from every province of the kingdom. Thus, his teaching was not only relevant for the few who entered an academic career, but also for very many who continued in different directions, including politicians, administrators, and ecclesiastics. At Fergola's death, his school began to lose its uniform character (while Fergola was alive, none of his students dared to open a private studio on his own). Vincenzo Flauti emerged in the 1810s as the new leading figure in the synthetic school, accumulating an unprecedented number of charges in public education, and controlling the mathematical activity of the Royal Academy of the Sciences (RAS). He was certainly one of the most powerful professors of the RUN, and one of the most famous scientists of his age. That this happened to a professor of mathematics is rather surprising, given the low prestige traditionally associated to scientific disciplines in Neapolitan academic life (law and medicine being the leading faculties). As an example of Flauti's power, we could cite his monopoly over the production of university and college textbooks of mathematics all over the kingdom (Flauti's edition of Euclid's *Elements* had no less than twenty-two editions, granting its author scientific success as well as remarkable revenues).

We said Fergola's influence was "almost" uncontested. Indeed since its very beginnings the synthetic school was opposed by those who inclined to adopt a purely analytic approach to geometry, on the track of the French and North Italian geometers, particularly of Joseph-Louis Lagrange (1736-1813). French analytic textbooks were already well diffused in the 1780s, mainly to be used in military schools, whereas, around 1790, the Lagrangian approach to geometry began to be preferred by some private teachers of mathematics. The French occupation of the kingdom (1806-1815) was the occasion for the supporters of analysis to consolidate their position and to give birth to a proper "analytic school", which was mainly based in the new School of Application of the Corps of Engineers of Bridges and Roads (*Scuola di Applicazione del Corpo degli Ingegneri di Ponti e Strade*), a school of civil engineering founded in 1811 and shaped on the model of the French *École de Ponts et Chausses*. Among those who supported the purely analytic approach to mathematics were Carlo Lauberg (1762-1834), who played a crucial role in introducing the "analytic spirit" in Napolitan mathematics in the early 1790s and, later, Ottavio Colecchi (1773-1847), Salvatore de Angelis (1789-1850), Francesco

Paolo Tucci (1790-1875), and Fortunato Padula (1815-1881). Roughly speaking, the first stage of the controversy had Fergola and Lauberg as its main actors, whereas since 1810 Fergola's pupils debated with the analytic teachers quoted above. While the basic beliefs about the nature of mathematical knowledge and its role in the wider framework of human knowledge remained stable over the fifty-year controversy, many of its aspects evolved. For instance Flauti's interests were significantly more narrow than Fergola's (limited to pure and descriptive geometry), whereas some of his synthetic colleagues became mostly interested in the history of mathematics. The controversy ended up in the 1839 challenge, followed by a rapid decline of the synthetic conception of mathematics, which apparently had lost much of its appeal to the new generation. The very meaning of the controversy went lost in the new context of "Italian mathematics", following the political unification of the country in 1860.

The question of which is the "proper" method to solve geometrical problems cannot but appear misplaced to contemporary readers. Even more obscure are the accusations of "moral depravity" and "anti-scientific attitude" that Neapolitan synthetics launched against those practising and teaching purely analytic methods in geometry. We read in their writings that such a moral connotation depended on an allegedly negative, "corruptive" effect of analytic methods on the minds of the students[3]. The reasons for such peculiar accusations are not clearly stated though: those who launched them took for granted some background knowledge which is not ours. What is clear is that the controversy over problem-solving methods in geometry was strictly linked to such questions as the hierarchical structure of different mathematical disciplines, the role of mathematics in university curricula, and the didactic function of mathematics. In the following, we shall describe the Neapolitan debate in its general features, and we shall take a look at the matter of the 1839 challenge. Let us begin by clarifying the basic terminology employed by these geometers, that is: what did they mean by "analysis" and "synthesis"?

Unfortunately for the historian, these very terms are polysemic to a degree matched by few other terms in philosophy of mathematics. They stem from Greek as composed terms: "analysis" (αναλυσιζ) can be translated as "back from solution", "back from conclusion", or "resolution" (this is the standard Latin translation: *resolutio*); "synthesis" (συντεσιζ) can be translated as "to put together", or "to compose" (standard Latin translation: *compositio*). However, in Greek there is not a direct opposition between the two terms[4]. So, for example, Penelope "analysed" her web during the night, but she did not "synthesise" it during the day (rather, she "wove" it)[5]. On the other hand, "synthesis" is referred by Aeschylus to the act of putting letters together to form a word: but there is no reference to any sort of analysis to be accomplished before or after this act of synthesis[6]. Moving from every day language into philosophical and mathematical terminology, the two terms underwent a long series of meanings-shifts which it is not of interest to describe here. Let us just note that Marco Panza and Michel Otte listed not less than eighteen different interpretations given to the two terms by mathematicians (to define different styles of mathematical reasoning) and philosophers (to clarify the nature of mathematics and of knowledge in general)[7]. But, what about the interpretation shared by Neapolitan geometers? A first, very simple example, will help us to draw a rough divide between the two methods used by the Neapolitan geometers, and in so doing we will shed light on the meaning of the terms "analysis" and "synthesis" in this context.

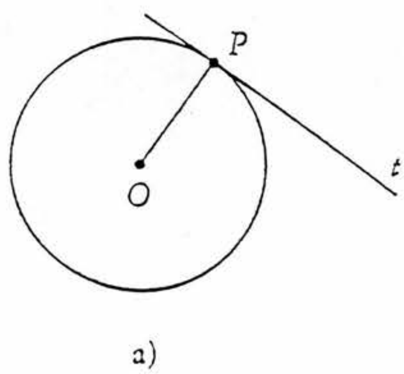
When studying the properties of the conic sections, the student was asked to solve problems such as the following: how can we trace the tangent **t** to a given circle **C**, at the point **P** ? Following the instructions contained in a textbook of the synthetic school, this problem is solved by performing a geometrical construction: this consists in tracing the radius **OP** and then tracing the line **t** passing through **P** and perpendicular to the radius **OP** (fig.1a). According to the instructions contained in an analytic textbook, however, the problem is solved through the use of algebraic algorithms. Firstly, one translates the terms of the problem in algebraic form, by choosing an opportune system of coordinates: in this case the one centred in the circle's centre; with respect to these coordinates the equation of the curve is

$$x^2 + y^2 = r^2,$$

and the point **P** will be individuated by the couple (a,b) (fig.1b). Secondly, one puts in a system the equations of the curves whose points of intersection are crucial for the solution of the problem: in this case the equation of the circle and the general equation of a straight line passing for the point **P**, which is

$$y - b = m (x - a),$$

Figure 1



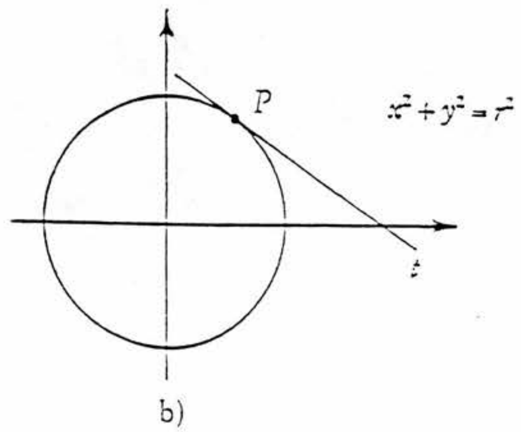
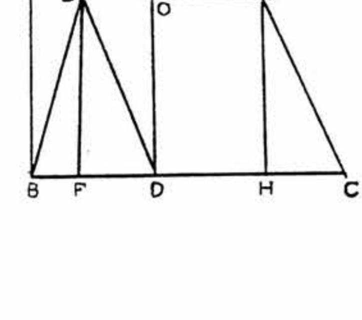


Figure 2



to calculate the gradient m of the tangent line t. The solutions of this system are the points of intersection between the straight line **t** and the circle (which, in the case of the tangent, do coincide). Solving the system, the following equation of the tangent line is obtained:

$$ax + by = r^2.$$

Now, the first method was held, by the members of the synthetic school, as to be the only proper method to solve a geometrical problem. They referred to it as to the "synthetic method" (*metodo sintetico*), or "composition method" (*metodo di composizione*). The second, an approach to geometry developed since the seventeenth century, was recommended by the members of the analytic school. They referred to it is as to the "analytic method" (*metodo analitico*); more specifically, they called their own method "two or three coordinate geometry" (*geometria a due o tre coordinate*), or "Lagrangian method". This example does not shed light on the real practice of the two methods, but it is sufficient to bring out what was seen as a crucial difference between them, namely, their degree of generality. In fact, the two methods sketched above could be characterised in a number of different ways, but Neapolitan geometers gave most weight to the criterion of generality. Let us go on then, by describing the methods from their own point of view. In the first method of solving the problem, we have utilised a specific feature of the circle —namely the fact that the tangent to a circle at a point **P** is always perpendicular to the radius **OP**. If one were to consider the case a different kind of curve, a parabola for example, or an ellipse, some different characteristic of the curve in question should be employed in order to solve the same kind of problem. For instance, to find the tangent at a certain point **P** in the case of an ellipse, one should consider the following property: the tangent in **P** is bisector of the angle between the straight lines connecting the two foci to **P**. The second way of solving the problem, the analytic one, is a very different one. The procedure is unchanged whether one is considering a circle, a parable, or an ellipse. In this sense the analytic method is more general and easier to employ. Nevertheless, it should be noted that when using this method, information about specific properties of the studied curve becomes not only unnecessary but also much more difficult to establish. So the fact that the tangent in **P** is perpendicular to **OP** can be stated only by recognising the validity of the following algebraic equation

$$b/a\,(-a/b) = -1,$$

where b/a is the gradient of the radius **OP** and $-a/b$ is the gradient of the line **t**. This means that while the analytic method is completely adequate for solving the problem, it fails to provide information that is immediately evident when using the synthetic method. It should be also noticed that in the synthetic method the geometer looks constantly at the figure in order *to see* which are the possible relations between certain parts (in this case, the tangent and the radius). Consequently, although one can achieve a certain degree of generality in his considerations, he never distance himself from the concreteness of the figure. In the analytic method, the geometer immediately achieves a much higher degree of generality by translating the conditions of the problem in algebraic language; in this phase variables and parameters are added precisely to make his considerations much more general, so that all the possible cases falling under the initial conditions of the problem are actually considered. Schematically, then:

1) synthetic method: one assumes the tangent as already traced → one sees that for every possible position of **P**, the tangent would be orthogonal to the radius in **P** → one already knows how to trace a radius in **P** ⇒ one constructs the radius in **P**, and then traces the tangent **t** in **P**.

2) analytic method: one considers which quantities would bring us, if known, to the solution of the problem → these quantities are taken as unknowns → the conditions of the problem are expressed in the form of algebraic equations, and parameters are introduced in order to consider all the possible cases → the equations are put in a system and solved, in order to find which values satisfy all the conditions ⇒ the tangent can now be traced translating the numerical values in their geometrical representation.

Accordingly, here is how the two methods were described:

1) the synthetic method is *specific*. Every problem to be solved calls for a different construction; thus the geometer requires skill, knowledge and experience which can be gained only through a long training. This method relies largely on the intuition of the geometer, who must *see* the relevant relations between figures, and choose the more suitable construction for each particular problem. Solving problems is a difficult and sublime "art".

2) the analytic method is *general*. Every problem can be put in equation, and then mechanically solved. Through solving the "equation of the problem", one obtains all the possible numerical solutions for the original geometrical problem: nothing seems to be left for the intuition of the geometer. Solving problem consists in following a "mechanical procedure" and everyone, with little practice, can do it.

More generally, Neapolitans used the terms "synthetic" and "analytic" to refer, respectively, to the use of geometrical and of algebraic reasoning in problem-solving; so that "synthesis" was commonly synonymous for "purely geometrical procedures", and "analysis" for "algebraic or infinitesimal procedures". But this was not the only meaning attached to the couple analysis-synthesis. Another, more ancient use of these terms was followed in the context of the purely geometrical problem-solving procedures. Thus, before going on with the historical reconstruction of the controversy, it is necessary to know something more about the nature of the geometrical problem-solving procedure, and about this other meaning of the couple "analysis and synthesis", a meaning which, in Neapolitan writings, coexists with the one stated above.

In fact, geometrical procedures employed by the synthetics were much more articulate than the previous example could suggest. These procedures were derived from a corpus of ancient texts which included works by Euclid, Archimedes, Apollonius and by later commentators such as Pappus. These texts were scrupulously studied by the synthetics, and some of them were in fact employed as textbooks for their courses. The Neapolitan school of synthetic geometry considered itself as the legitimate heir of the classical geometric tradition, or "the Greek school" as they used to call it. In their historical reconstruction of the evolution of mathematics, they were the last ring of a long chain which linked Greek geometers to Renaissance geometers, to Galileo, to the great seventeenth century geometers such as Viète, Descartes, and Newton. Now, not only the idea that such a heterogeneous lot of mathematicians can be presented as sharing some unitary conception of mathematics and a common geometrical problem-solving method is hardly plausible, but also the idea that all Greek geometers employed a common and well-defined method in their own research has been challenged by historical scholarship[8]. Programmatic claims should be handled with care: in this case their function was more that of *creating* a previous tradition, than simply referring to it.

Let us see, anyway, what Neapolitans found so crucial in the "ancient tradition of geometric problems".

Already during the fourth century B.C., Greek geometers dealing with the problem of cube duplication had developed a set of geometrical techniques which would later become part of the classical problem-solving tradition. Among these techniques there was the twofold procedure of "analysis and synthesis", which was "familiar as an instrument for the solution of problems several decades before Euclid"[9], and was to reach its highest refinement in the work of Apollonius (circa 262-190 B.C.). According to this tradition, a geometric "problem" (from *proballein*, "to cast forward") seeks the construction of a figure corresponding to a specified description. Basically, a problem is solved by reducing it to others which have been already solved. The twofold method included a process of analysis which consisted of the following steps: 1) the desired figure is posited as if it had been already constructed; 2) a series of properties are deduced from it, until some element is reached which is known to be constructible from previous results. Then, a process of synthesis begins. It starts from the constructible elements to which the original construction has been reduced and, following approximately the reverse order of analysis, it leads, through a series of deductions, to the desired construction. If we look to our first example, we can recognise a very simple example of the twofold process at work: we start by assuming we have already traced the tangent, we see that it would be orthogonal to the radius, the radius is something we already know how to construct; then we trace the radius and we trace the tangent as orthogonal to it. In other words, analysis moves from the unknown as if it were known to its possible antecedents until arriving at premises we recognise to be known; whereas synthesis moves from the known to what we have to construct to solve the problem (this definition seems to coincide with what Panza and Otte called the "directional interpretation" of the terms "synthesis" and "analysis"). Historians agree that the procedure of analysis was the privileged heuristic method in the ancient tradition. Indeed, it is suitable for advanced geometric research, given that it can be used even when the solution of a problem is not yet known. Nevertheless, when it came to presenting results in a systematic way, Greek geometers gave priority to the synthetic method. Classical synthetic textbooks, such as Euclid's *Elements* or Apollonius' *Conics* became exemplary tokens of demonstrative rigour; but still, they did not expose the original reasoning of the geometer and the rationale for his choices, so that their solutions of problems and their demonstrations of theorems are rich in (apparently) arbitrary steps, whose reasons remain obscure until the result is eventually reached. Greek geometers also wrote texts where the analytic method was presented, in order to train students in this practice, but very few survived, such as Euclid's *Data*. This lack of information about the practice of analysis helped to consolidate a particular image of the ancient tradition among modern geometers, an image which was characterised by compilations of bodies of theorems ordered according to the rigorous deductive steps of the synthetic method[10]. It should be noted that the priority of the synthetic method and of theorems over problems in the surviving corpus of Greek texts is not entirely the result of historical accidents. In fact, authors of late commentaries such as Pappus and Proclus, whose work is crucial for our knowledge of the ancient geometrical productions, manifested an evident predilection for synthesis, theorems and formal proofs. As a result, they presented a somewhat distorted image of the ancient tradition, which was transfigured according to their own particular philosophical interests. The ancient tradition was centred on exploiting the heuristic power of the analytic method in order to solve problems, which was the main goal of geometrical activity; and that in this context the formulation of theorems and the synthetic presentation of geometrical results was conceived as a secondary activity. The reasons for the different weight given to methods and themes by later commentators is to be found in the particular function that mathematics played in their own intellectual project. Generally, they were not mathematicians involved in original research, but Neo-Platonic philosophers with an interest in mathematics as a purely abstract and rational science. According to them, mathematics deals with the world of eternal and immutable essences, and the statement of a theorem is the description of an eternally true state of (ideal) things. Reasonably then, the theorematic form, which can be seen as essentially "static", was preferred to the problematic form, which can be seen as essentially "dynamic". Indeed, in solving a problem the geometer performs certain operations with and on geometrical entities, modifying them and bringing new entities into existence. These considerations can make sense of why the analytic side of the old twofold solutions was often eliminated by later commentators, who regarded it as "merely" heuristic and eventually unessential, being interested only in the ideal and timeless state of things. Instead, the procedure of analysis was used in purely speculative investigation over theorems, an application scarcely supported by the practice of previous geometers, and which seems to betray the original heuristic function of this method[11].

It is this image of the ancient tradition, as one eminently interested in demonstrative rigour and logical deduction, that "modern" geometers found unsatisfactory in the seventeenth century[12]. The introduction of algebraic and infinitesimal methods to solve geometrical problems was in many respects a response to the limited heuristic power of the techniques offered by the received tradition; a replacement of the ancient analysis with the new analysis of the moderns. But this was not the only possible way to overcome what was generally perceived as the impasse of geometry. Some modern geometers decided to revive the original analysis, reconstructing its procedures on the basis of the scarce information available (hence a series of "divinations" of the lost analytic texts). In the particular intellectual context of the late eighteenth century this *querelle* was to be revived once again by the Neapolitan synthetic school, in its singular and obscure fight against "the mathematics of the moderns".

1.2 Synthetic, Cartesian and Lagrangian Method

We shall now go through some problem solutions extracted from two of the most representative Neapolitan textbooks. Their exemplary character, and their being slightly more complex than the previous one, will make us appreciate the real working of the two methods. Let us begin with an excerpt from Fergola's *On Geometric Invention* which circulated in the synthetic school as a manuscript from 1809, and which contained a *summa* of Fergola's ideas about how to train students in problem solving (indeed Fergola had originally titled it *The Heuristic Art*)[13]. The text introduced students to "the art of geometrical analysis" through principles, canons, and examples. Consider the following case:

Problem:

Given a triangle ABC of kind and of magnitude, inscribe a square in it, whose side lies on the basis BC (fig.2).

Geometrical analysis (step 1): supposition of the fact

Suppose as already inscribed in ABC the square EGHF, so that the side FH lies on BC and the angles FEG and HGE lie in the sides AB and BC. Suppose O be that point of AD such that tracing for it EG parallel to BC and for E and G the perpendiculars EF and GH, be EF=GH=EG.

Geometrical analysis (step 2): consequences of the supposition

Supposed EG=EF, then EG:AO=DO:AO. [1]
Than , for the nature of the triangle, EG:AO=BC:AD. [2]
So, BC:AD=DO:AO.

Geometrical analysis (step 3): reduction of the problem

Since DO:AO=BC:AD, and since BC and AD are given of magnitude, the problem can be reduced to that of dividing AD according to a given ratio; otherwise, to that of finding two segments whose sum is given and whose ratio is also given. This can be done as seen in a previous paragraph.

Geometrical composition (step 1): construction

Trace from B the perpendicular BP, equal in length to BC. Trace PD, to find the point E on AB; and trace EG parallel to BC. For E and G trace now the two perpendiculars EF and GH. EFGH is the square the problem asked for.

Geometrical composition (step 2): proof

It is PB:EF=BD:DF, or EO.
And BD:EO=BC:EG
Than PB:EF=BC:EG.
So EF=EG, and EGHF is a square, inscribed in ABC.[14]

According to Fergola, this was the proper sequence of steps in order to analyse and to compose a problem, and to prove the specific geometric truth that has been found. To sum up, geometric analysis consists of the following steps:

1) Suppose done what is asked in the problem ("supposition of the fact");

2) Develop the consequences of this supposition. One should look both at the consequences deriving from the conditions of the particular problem (from here —in our example— one gets the proportion [1]) and at the consequences deriving from the nature of the figure(s) involved (from here the proportion [2]).

3) Find one consequence which is constructible (that is, which reduces the problem to one already solved).

This solution is "very simple", Fergola concludes, because accomplished with "the minimum use of reasoning [*col menomo dispendio di ragioni*]"[15]. In his historical remarks, Fergola attributed (erroneously) to Plato the discovery of the method of geometrical analysis, concluding:

> if an inventor excels a wise scientist as the scientist does the ignorant people [*ignaro volgo*], how much is worth the one who discovered the art of inventing? Plato discovered it at the very beginning of Geometry, [...] and I think that this great man should be said for this, more than for any other philosophical speculation, the *divine genius*, as if an angelic mind would have penetrated into a human brain.[16]

Unfortunately, Fergola continued, "destructive time has not transmitted to us the heuristic principles of Greek geometers"; his own task was precisely providing students with some rules based on ancient documents and on the discoveries of modern geometers. To this extent, he began with the definition of geometric analysis provided by Theon of Alexandria: "[analysis] est sumptio quaesiti tanquam concessi, per ea quae consequuntur in aliquod verum concessum"[17], and from this he developed four informal "heuristic canons" that should be kept in mind while analysing problems (basically, they codify the three-step procedure shown above). The geometrical analysis of a problem is an "ontological principle of reduction, that is a rich source of truths and methods", Fergola declared[18]. He also referred to it as "the art of inventing", which is "one of the most beautiful dianoethic virtues" ("dianoethic" meaning —in Scholastic terminology— purely intellectual, as opposed to empirical, practical); it is either a natural gift, as in the case of Newton, or the result of an assiduous training[19]. But completing the analysis of a problem is only part of the task of the geometer. After the "reduction" of the problem, which lead to some previously known geometrical truths, it is necessary to perform the "geometrical composition of the problem", according to "the doctrine of Pappus"[20], who indeed placed great emphasis on the process of "constructing" and proving the solution of the problem. The material for performing the construction and the proof (which together make the "composition" of the problem itself) are already contained in the previous geometrical analysis through which it has been solved. But the neatness of the composition, its elegance, depends entirely on the way in which these materials are chosen and re-arranged by the geometer, i.e., in the end, on his "skill and ingenuity" (*arte e ingegno*). The construction of the problem generally proceeds, as we said, in the reverse way of analysis, i.e. from the known geometrical truths to the construction required by the statement of the problem. We said "generally" because the complete reversal of the analysis into the composition is not always possible, or desirable. The geometer can indeed decide to employ indirect forms of reasoning, such as the *reductio ad absurdum,* or to introduce some independent geometrical truths (in the form of "lemmas"), in order to make the composition more direct and elegant. In this case, there is no strict correspondence between analysis and composition, and the simple knowledge of the composition of a problem is insufficient to reconstruct its original analysis (from here comes the difficulty in reconstructing the lost analytical works of the ancients). In fact, even in this simple example, we can see that Fergola preferred not to move backwards from the reduced problem, but he rather found a simpler and quicker way to compose it. This showed to the student that the skilled geometer was in fact only loosely bounded by methodological principles, and that "the art of inventing" depended very much on his own intuition. About the second stage of the composition, Fergola remarked that "a proof is needed to allow the construction"[21], as is clearly shown in Euclid. In practice, the constructed solution is turned into a theorem for which a proof is then provided (Fergola used the puzzling expression "proof of a problem").

Emulating the twofold method of the ancients was certainly Fergola's basic aim. Thus, the reader might be surprised by finding that Fergola devoted part of his book to algebraic problem-solving methods, which were proposed to students as good techniques to deal with certain kinds of problems. In fact the contradiction is only an apparent one. To clarify this crucial point, let us introduce a distinction between two different ways in which algebra can intervene in the problem-solving process.

1) According to the **Cartesian method**, or "mixed method", the use of algebraic algorithms coexists with the consideration of geometrical figures as a constitutive part of the problem-solving process. This reduces the role of analytic tools to a subsidiary, economic one. In principle, any of the analytic passages could be eliminated and replaced by the correspondent geometrical reasoning. Moreover, for a problem to be said to be properly solved, a final "construction" of the solution must be performed, which translates the analytic solution into its geometrical form.

2) According to the **Lagrangian method**, or the "very modern [*modernissimo*] method", problem-solving is not introduced by any preliminary construction, as in

the Cartesian, but rather by the preparation of a set of very general formulas which can be thought of as expressing metric relations between geometrical figures[22]. Then, these formulas are manipulated so to obtain the desired results. Such a manipulation of algebraic and infinitesimal algorithms can be performed without *looking at* any particular figure. This means that analytic reasoning is often not translatable in some corresponding geometrical step. Eventually, finding all the possible solutions (numerical values) for the solving equation means having solved the problem itself, and no final geometrical construction is performed (it is taken for granted that equations are always constructible, if one is interested in this kind of activity). In this method analysis is not a subsidiary tool, but rather an independent and fully legitimated way of reasoning which allows the geometer to discover new geometrical truths in a mechanical and non-intuitive way. Furthermore, by being detached from geometrical reasoning over particular figures, this method enable the geometer to generalise his results and his procedures to a much higher degree than the Cartesian method itself.

The last method was called "Lagrangian" because it had been given exemplary employment by Lagrange in his famous essay on triangular pyramids (1773). It is important to recall some of the programmatic statements contained in this work, given that Neapolitan analytics were to take them as a basis for their own geometrical research and teaching. First of all, one should note the extreme generality of the subject treated by Lagrange: the essay is on "la manière de trouver la surface, la solidité, les sphères circonscrites, le centre de gravité, etc., de toute pyramyde triangulaire dont on connait les six côtés"[23]. Then, the author remarked that his essay could be of interest to geometers not only because of its particular results, but also because of its innovative method: indeed it provided solutions which are "purement analytiques et peuvent mème ètre entendues sans figures". This is an approach to geometry where particular figures (such as those we deal with when we solve a typical synthetic problem) are irrelevant. The geometer is not interested in the features of a particular figure, but only in the very general relations existing between different classes of figures, or between different parts of some typical figure (as — in this case — the pyramid).

> [J]'y emploie des coordonnées rectangles pour determiner la position des differents points que j'ai à considerer dans la pyramide, et je n'ai pas même

besoin de donner aux axes de ces coordonnées une position déterminée; je suppose seulement qu'ils se coupent au sommet de la pyramide, en sort que pour ce point le coordonées soient nulles, ce qui sert à simplifier les formules sans rien ôter à leur généralité. Par ce moyen tout se réduit à une affaire de pur calcul, et il est très facile de déterminer la valeur des lignes qu'on veut connaître, puisq'il ne faut que prendre la somme des carrés des différences des coordonnées qui répondent aux deux extrémités de chaque ligne proposée. Il ne s'agit plus ensuite que de rendre les résultats indépendents de la position arbitraire des coordonnées, en introduisant à leur place d'autres lignes relatives uniquement à la figure de la pyramide, comme les còtés de la pyramide, les perpendiculaires sur ses faces, etc.; c'est à quoi je parviens à l'aide de quelques réductions et transformations assez remarquables que j'expose au commencement de ce mémorie, et qui pourront être aussi du plus grand usage dans beaucoup d'autres cas. Indépendamment de l'utilité directe que ces solutions pourront avoir dans plusieurs occasions, elles serviront principalment à montrer avec combien de facilité et de succès la méthode algébrique peut être employée dans les questions qui paraissent être les plus du ressort de la Géometrié proprement dite et les moins propes à être traitées par le calcul.[24]

One innovation of the Lagrangian approach with respect to the Cartesian is its much higher level of generality. This is obtained by moving the attention from particular constructions (such as tracing the tangent to a given circle passing through a given point), and from the scrutiny of particular dispositions of figures, to general considerations about the properties of entire classes of figures (such as metric relations of pyramids), to which problems must now be referred (and the more a problem is general the more it is "interesting"). In the Cartesian approach the role of the figure is still crucial. Indeed, the solution of problems such as those treated by Lagrange in his essay, should begin with some preliminary considerations about the particular figure, which include the choice of an appropriate system of coordinates. Then, in the solution, geometric similarities and Pythagoras' theorem would be repeatedly employed, and these actions would be translated in algebraic terms. Lagrange started instead by presenting some general sets of formulas which hold whatever the system of coordinates, then he provided general solutions for entire families of problems just by manipulating such formulas. As a result, Lagrange remarked, geometric problem-solving reduces to "a question of calculation"; preliminary geometric constructions being in fact eliminated. Furthermore, Lagrange ignored the final composition of the problem, considering its algebraic analysis as the only relevant goal.

We should now see why, in the eyes of Fergola and of the members of his school, the Cartesian method was as legitimate as the synthetic one. The reason was precisely its essential contiguity with geometrical reasoning: from the preliminary construction, to the analysis to the construction of the solving equation, to the final proof, the Cartesian method could be thought of as "mirroring" geometrical reasoning and of geometrical manipulation. The point was that, given the loss of the ancient techniques of geometrical analysis, geometers needed the new algebraic analysis in order to pursue their problem-solving activity. In a metaphor which was widely used in the synthetic school, these two methods should become "the two wings" which let the geometer advance in his exploration of geometrical truths. This also means that synthetics, and particularly Fergola, did not oppose modern analysis *tout court*; they were not merely asking for a return to the ancient tradition of problem solving. Rather, the nature of their claims was, in modern terms, a foundational one. What they argued for was the foundational role of geometrical reasoning with respect to algebraic and infinitesimal reasoning, of synthesis with respect to analysis.

If we now return to Fergola's textbook, we can make sense of why he extended his presentation of the art of inventing to the case in which the Cartesian method is used instead of the purely geometrical one. In some cases he in fact offered two solutions for the same problem, one algebraic and one geometrical (i.e., "the two methods of geometrical invention"), pointing out that the general structure of the solution is essentially the same: analysis→composition→proof. This means that, even when he employed algebraic algorithms to solve a problem, Fergola always considered his reasoning as essentially geometric. Otherwise, the requirement of the geometrical construction and of the final proof after the algebraic solution would make no sense at all.

Among the four canons introduced to guide students in the solution of problems[25], the third and fourth are precisely about using algebraic equations to solve problems, by means of translating the conditions in algebraic language, solving the final equation, constructing and proving them. Such a problem-solving method required the student to be trained in certain mathematical techniques which a modern reader would judge rather odd. It is the case, for example, of the technique of "constructing equations", a field of study whose popularity had greatly declined in the second half of the eighteenth century, but whose practice was simply necessary in order to geometrically construct problems which have been solved by means of algebraic analysis[26]. Similarly, Fergola insisted on the necessity of "proving a problem which has been analytically solved". If you wonder what this could possibly mean, here is an example offered by Fergola himself (Fig.3). Basically this technique consisted in going backward from the roots of the solving equation to the initial conditions of the problem. In a similar spirit, Fergola provides exercises and guidelines in order to train the student to provide a synthetic proof for a problem which has been algebraically solved[27]. To this extent, algebraic expressions must be replaced by equivalent geometrical magnitudes, and equations must be replaced by proportions. The chain of deductions which form the proof will be obtained by constructing the roots of the solving equation, going backwards to the equation itself, and from this to the conditions of the problem, translating in synthesis those passages which would make the analytic proof seen above.

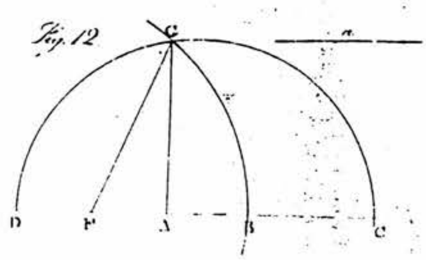
In the end, even if algebraic means were allowed in problem-solving, the necessity of the geometrical construction of the problem and of its demonstration, made clear that the use of analysis had always to be founded on some "deeper" geometrical reasoning. This made it necessary that "not only must the geometrical construction of analytic expressions be clear and familiar to the analyst; but also the synthetic means and the rigorous proving"[28]. The statement of the last "principle" of the section devoted to the analysis of problems is extremely clear about the relation between geometry and algebra in problem-solving: "a geometrical problem, which is solved analytically, cannot be considered properly solved if it is not constructible". This derives from the very "nature of geometrical problems", Fergola said, citing the importance of constructing problems in classical sources and in Descartes' *Geometrie*. In Fig.4 a schematic representation of Fergola's ideas about problem-solving is provided. Philosophically, it reveals the fundamentally geometrical conception of problem-solving supported by Fergola; technically, it makes the use of algebraic algorithms purely instrumental, and provides a rationale for Fergola's re-adoption of certain old techniques of translation from algebra into geometry whose use would be otherwise obscure.

Figure 3

PROPOSIZIONE XXXVII.

PROBLEMA.

490. Data la retta AC [*fig.* 12.]; dividerla in B, sicchè il quadrato delle parte AB stia al rettangolo di tutta la AC nell' altra parte BC, in un data ragione, che per comodità di analisi sia quella di n ad AC.



SOLUZIONE ANALITICA.

Pongasi $AC = a$, $AB = x$; sarà $CB = a - x$, ed $AC.CB = a^2 - ax$.

Quindi essendo, per la condizione del problema,

$$x^2 : a^2 - ax :: n : a :: n(a - x) : a^2 - ax \qquad [A]$$

sarà, per la 7. *El. V*,

$$x^2 = an - nx. \qquad [B]$$

Ed aggiugnendo nx ad ambo i membri dell' equazione, sarà

$$x^2 + nx = an \qquad [C]$$

Ed a' membri di questa aggiugnendo ancora $\frac{1}{4}n^2$, risulterà

$$x^2 + nx + \frac{1}{4}n^2 = an + \frac{1}{4}n^2 \qquad [D]$$

Indi estraendo da ciascun di essi la radice quadrata, sarà

$$x + \frac{1}{2}n = \pm\sqrt{(an + \frac{1}{4}n^2)} \qquad [E]$$

E togliendo di comune $\frac{1}{2}n$, resterà

$$x = -\frac{1}{2}n \pm \sqrt{(an + \frac{1}{4}n^2)} \qquad [F]$$

Dal quale risultamento [F] ottiensi con cammino retrogrado la seguente

DIM. Essendo $x = -\frac{1}{2}n \pm \sqrt{(an + \frac{1}{4}n^2)}$ [F]

sarà aggiugnendo di comune $\frac{1}{2}n$

$$x + \frac{1}{2}n = \pm\sqrt{(an + \frac{1}{4}n^2)} \qquad [E]$$

Ed elevando questi due membri a quadrato, sarà

$$x^2 + nx + \frac{1}{4}n^2 = an + \frac{1}{4}n^2 \qquad [D]$$

Sicchè togliendo di comune $\frac{1}{4}n^2$, resterà

$$x^2 + nx = an \qquad [C]$$

E di nuovo togliendovi nx, si avrà

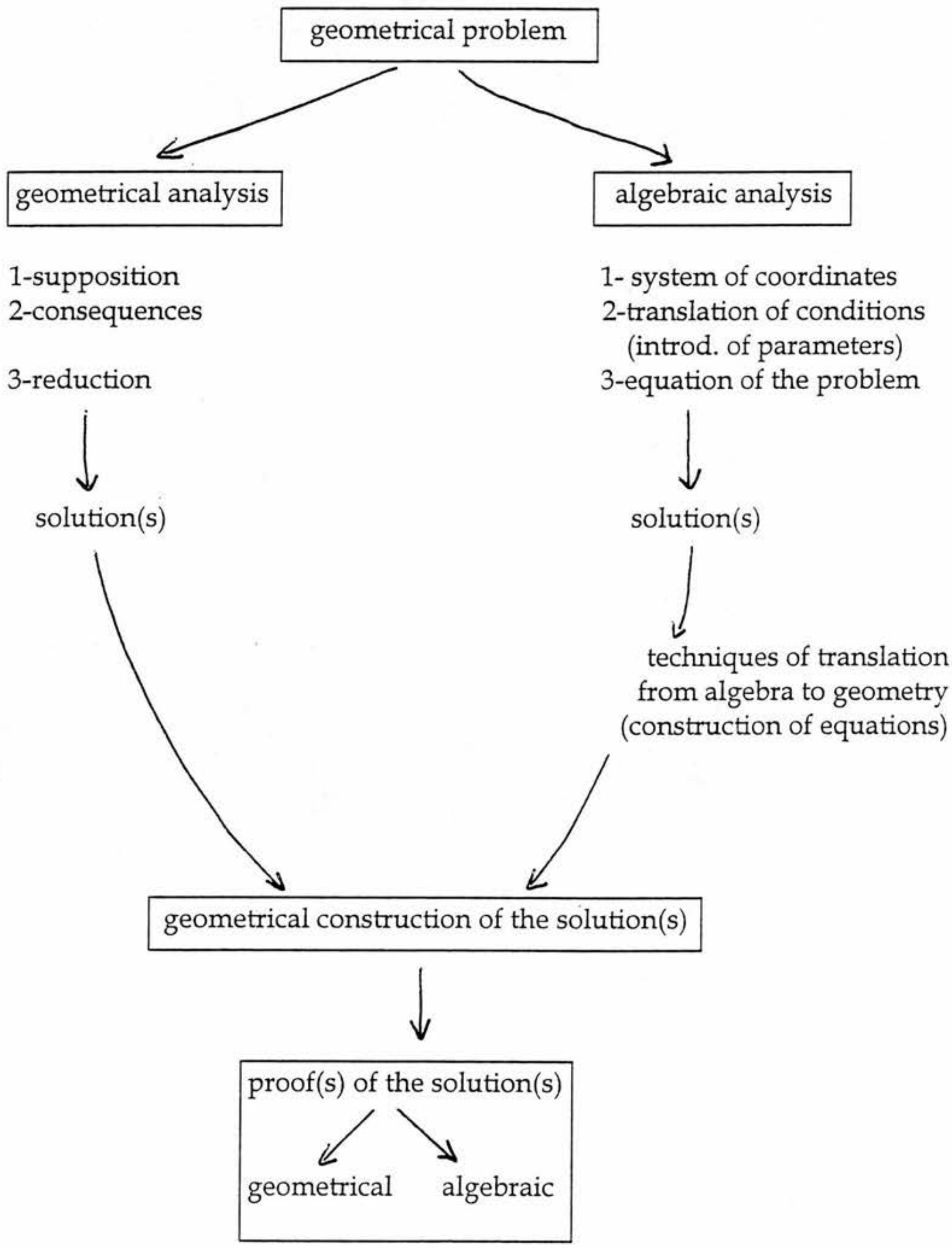
$$x^2 = an - nx = n(a - x) \qquad [B]$$

E quindi, per la 7. *El. V*, sarà

$$x^2 : a^2 - ax :: (a - x)a : (a - x)n :: n : a \qquad [A]$$

Figure 4

Fergola on problem-solving



The "mirroring" of geometrical reasoning into algebraic forms is shown in the analysis provided by Fergola for the problem of finding that triangle whose area, perimeter, and an angle are known (Fig.5). Note the preliminary construction (*l'apparecchio preliminare*) and the two analyses, geometrical on the left and algebraic on the right. Note how the algebraic solution, which is an instance of the Cartesian method, depends on a preliminary inspection of the particular figure, and contains continuous reference to it; and how the geometer keeps his algebraic considerations strictly linked to their geometrical meaning (note e.g. the move from a proportion to an equation).

We can now turn to an analytic textbook, to make a few remarks about the Lagrangian method as it was used by the opponents of the synthetic school. The book is a 1838 collection of geometrical problems published by Fortunato Padula. The collection included that kind of very specific problem in plane and solid geometry which were favoured by synthetics. The polemical aim is clear: Padula wanted to show how, taking inspiration from the Lagrangian work on pyramids, algebra can be effectively used in problem-solving, and particularly in dealing with that kind of problems the Greek-like synthetic solutions of which were proudly exhibited in Fergola's school. Padula refuses for algebra the ancillary role attributed to it by the Cartesian method, and he claimed that, apart from a few geometrical considerations on the kind of objects we are dealing with, the purely algebraic method is perfectly adequate for problem-solving (i.e. it is not in need of any geometrical "confirmation"). This assumption about the validity of algebraic reasoning brought, on the technical level, some evident modification of Fergola's methods. At the same time, having chosen to deal with particular problems, Padula had to compromise: the purely algebraic nature of Lagrangian method and its extreme generality are indeed diminished in this collection. In fact, Padula had to start by considering the figure; furthermore, he generally provided a final composition of the problem, i.e. instructions to move from the solving equation to the construction of the figure. Again, this last step can be explained by placing Padula's work in its context, which was that of a fierce attack against the synthetic school. The main accusation against the "indiscriminate" use of indeterminate equations *à la* Lagrange was precisely that the construction of the equation obtained in this way was often very difficult. In other words, the synthetics maintained that

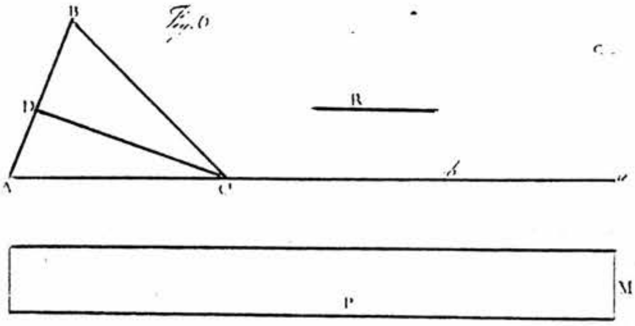
Figure 5

PROPOSIZIONE VIII.

PROBLEMA.

428. Costruire un triangolo, di cui sia data l' aja, il perimetro, ed un angolo.

Sol. Suppongasi essere ABC [*fig. 6.*] il triangolo richiesto, sicchè siavi dato l' angolo in B, ed oltre a ciò sia $AB + BC + CA = P$, e l'aja ACB uguale al rettangolo di P in M. Ed ecco di rincontro, nelle due seguenti pagine, i procedimenti de' due metodi, sintetico, ed analitico, onde potrebbesi guidare la soluzione di un tal problema.



Analisi Geometrica.

I. Si prolunghi il lato AC in a, sicchè sianvi le due parti Cb, e ba uguali a CB, e BA respettivamente, onde n' emerga tutta la retta Aa uguale alla data P.

II. Tirisi dal punto C la CD perpendicolare alla AB. Sarà [illegible] di specie il triangolo CBD, per esserne dato l'angolo B. [illegible] sarà data la ragione di BD a BC (§.60.), e quella [illegible] rettangolo ABD all' altro di AB in BC (*1.El.VI.*). Ma [illegible] esto rettangolo è dato, per avere una data ragione al dato [illegible] triangolo ABC (§.21.). Dunque sarà dato tanto il rettangolo di AB in BC, che l' altro di AB in BD; e questo potrà supporsi uguale ad $R \times P$, l' altro ad $S \times P$.

III. Intanto è

$$Aa^2 + Ca^2 = 2AaC + AC^2 \qquad (7.El.II.).$$

Dunque togliendo $Cb^2 + ba^2$ dal 1° membro di questo pareggiamento, e dal 2° togliendovi $CB^2 + BA^2$, cioè $AC^2 + 2ABD$, resterà

$$Aa^2 + 2Cba = 2AaC - 2ABD.$$

IV. Finalmente si pongano in questo pareggiamento le loro equivalenti quantità, avrassi

$$P^2 + 2R \times P = 2P \times aC - 2S \times P$$

cioè $$P + 2R + 2S = 2aC.$$

Dunque aC, o le due AB, BC hanno $\frac{1}{2}P + R + S$, per somma data, e contengono un rettangolo dato. E con ciò possono geometricamente esibirsi (§.14.).

Soluzione analitica.

I. Il dato perimetro del triangolo richiesto si chiami P; ed i due lati AB, BC di esso dicansi respettivamente x, ed y. Sarà l' altro lato $AC = p - x - y$.

II. È data l' aja del triangolo ABC, per le condizioni del problema; e per esserne dato l' angolo ABC, e quindi il rapporto di esso triangolo al rettangolo di AB in BC(§.21.), sarà però dato tal rettangolo, che si esprima per pc; quindi

sarà $$xy = pc,$$

e con ciò $$y = \frac{pc}{x}.$$

III. Ed esprimendosi la data ragione di CB a BD per $n:m$ sarà $n : m :: ABC : ABD$, cioè $n : m :: pc : ABD = \frac{mpc}{n}$

Ed essendo $$AC^2 = AB^2 + BC^2 - 2ABD,$$

sarà $$(p - x - y)^2 = x^2 + y^2 - \frac{2mpc}{n}$$

IV. Si contraggano i termini della precedente equazione,

sarà $$p^2 - 2px - 2py + 2xy = \frac{2mpc}{n}.$$

Ma qui sopra si è dimostrato $xy = pc$, ed $y = \frac{pc}{x}$. Dunque riportando tali valori in quell' equazione, ne risulterà

$$p^2 - 2px - \frac{2p^2c}{x} + 2pc = \frac{2mpc}{n}$$

cioè $$px - 2x^2 - 2pc + 2cx = \frac{2mcx}{n}.$$

when the geometer loses sight of the geometrical meaning of the quantities he is dealing with, he reaches results which make sense algebraically, but are difficult to construct geometrically. Padula wanted to show that this is in fact false, and he provided constructions for each problem. But, at the same time, he assured the reader that a problem can well be considered solved without the final construction (let alone the final proof).

The very first problem of this collection is a problem of plane geometry. Padula provided a few preliminary considerations about the figure, then he put the problem in the form of an equation. The original problem is reduced to that of finding the points of intersection between an hyperbola and the given parabola. As we said, the purity of the Lagrangian method is here compromised by particular considerations; still, what remains is the "spirit" of that method, as Padula calls it. Indeed, the original problem is immediately generalised by introducing appropriate variables and parameters, so that solutions can be provided for all possible cases deriving from the original terms of the problem (see **Appendix 1**). Padula provided his collection with a strong methodological uniformity; the reader was supposed to perceive a unique, general and effective approach to geometrical problems, which did not depend on the nature of the problem themselves. We can imagine how this impression of uniformity was powerful only by comparing this book with previous and contemporary synthetic books, where problems were differentiated, classified, and solved employing a number of different *ad hoc* strategies. Instead, the general rules employed by Padula to put a problem in equation are invariably the following ones:

1) assume as unknowns the coordinates of that point, line, angle,... that, if known, would determine all the other quantities, solving the problem;

2) express these quantities as function of the unknowns;

3) express with the "algebraic language" the conditions of the problem: it results immediately in an equation.

In the example reproduced in the **Appendix 1**, it was clear that the problem would be solved if one knew the position of the point M. This is why Padula took its coordinates as unknowns. Then Padula translated the conditions of the problem in algebraic terms, that is he translated in algebraic language the graphical operations that should be performed to solve it (in this case: tracing AM to find N on the parabola, tracing MP and NQ parallel to AR, and comparing PQ with CB; in algebraic terms: to find the equation of AM, the coordinates of N, by combining the equations of parabola and straight line, to find the abscissas of P and Q, and eventually put PQ equal to CB). Padula wanted to show how the practice of problem-solving radically changes when one employs the Lagrangian algebraic approach. Even when dealing with specific problems, he argued, such method remain highly general and allows the reader (i.e. the student) to solve every problem by following the same procedure. This increased methodological generality, and the consequent uniformity in the practice of problem-solving were, in the eyes of Padula, crucial advancements for the science of geometry. "It is for sure" Padula argued, "that with a little practice in the application of this method, and with the comprehension of its spirit, it will be possible to put in the form of an equation any problem, as soon as we read its conditions. We cannot imagine how this could happen using geometrical analysis"[29]. Not only did the new method allow the geometer to immediately put every problem in the form of an equation; it also *mechanically* guided him in discovering every possible solution to the problem itself, by considering every possible case which fell under the initial conditions. In commenting upon a problem which had a large number of possible solutions, Padula remarked:

> the true solution of a problem is its solving equation, whereas the construction is a secondary operation; indeed the algebraic solution for the different forms that the problem can assume is always one, and from this solution, as from a general source [*fonte*] the particular constructions are derived [...].[30]

A problem is solved when its solving equation is reached; if then one is interested in performing every particular construction deriving from the solutions of the equation, this can be easily done just by following the rules of algebra. What is important is that this can be done "without referring any more to particular considerations about the original figure". On the contrary, if a geometrical analysis has been performed, particular positions of points can be discovered only by going back to the figure and sometimes by re-analysing the problem itself in order to see how to modify the solution. Moreover, Padula remarked that from the equation of the general case, a much higher number of possible constructions can be derived than from the synthetic consideration of the figure. So it can be often the case that, thanks to algebra, one recognises a certain problem being just a particular case of a quite different one; "whereas to one who is only familiar with geometrical considerations, such a case would seem to be a completely different problem". The mechanical procedures of algebra bring out relations that the synthetic geometer simply cannot *see*. Padula also stressed that for each case he offered different solutions, "and from this point of view one cannot but recognise the superiority of the algebraic method over the method of the ancients, given that the fecundity of algebra is such that we could say that the solutions to a problem are almost infinite in number"[31].

The application of Lagrangian algebraic procedures brings uniformity, generality, and mechanisation in the process of problem-solving. It provides the geometers with a very high number of possible solutions, many of which could not be spotted by the direct analysis of the synthetic method. "This clearly shows how very different the two methods are, and how much algebra makes problem-solving easier"[32], concluded Padula. If the ideal synthetic geometer was a gifted and skilled contemplator of intuitive geometrical truths, the analytic was a practitioner who, with "a little practice", mechanically solved problems by implementing a general and effective method.

As we have seen in our previous examples, both methods provided the geometer with a "reduction" of the original problem to more simple tasks that he was already able to perform. The point is that in the synthetic method the analysis reduces the construction sought in the original problem to some other construction which is already known to the geometer. The reasoning remains contained in the specific field of geometry; it is on geometrical figures, their properties and our manipulation of them. And this being strictly contained in the field of geometry is indeed the reason why the composition of the problem result (almost) immediately from the results of its analysis. If we now think about the Lagrangian method, or rather the application of it to the case of solving particular problems, we see that things are quite different. The geometer analyses the problem by reducing the original geometrical construction to some simpler task: but the nature of this simpler task is not geometrical any more. It rather consists in solving some system of equations, each solution being one possible solution, in algebraic terms, for the original problem. In the case of the Cartesian method the essentially geometrical nature of the problem solving-process is maintained by the composition of the problem, which is usually quite straightforward, given the specific algebraic translation performed at the beginning of the solution. But when it comes to the Lagrangian approach, the geometrical nature of the problem-solving process is definitely lost. In this case the "algebraic language" enters the process not as an aid to geometrical reasoning, but as a method which is legitimate in itself. The roles of algebra and geometry are then reversed: for the analytics algebra, a general method of dealing with problems, is simply *applied* to the case of geometry. Lagrange himself was very clear on this point: in his essay on triangular pyramids he was not primarily interested in investigating the geometrical properties of such figures, rather, he wanted to show how "the algebraic method" could be fruitfully used in solving even those problems which were considered most suitable for a purely geometrical treatment. His last two sentences read:

> Par le moyen de ces formules et de celles que nous avons trouvées précédemment on pourra résoudre différents Problèmes curieux et nouveaux sur les pyramides triangulaires; mais en voilà assez sur un sujet que je n'ai presque traité que pour donner un exemple de l'application de l'Analyse à ces sortes des recherches.[33]

The analyst deals with geometrical problems mainly because he is interested in applying his algebraic and infinitesimal procedures to the particular field of geometry. It is, in other words, to underline once again the power of this way of reasoning. This is why he chooses those kinds of problems which seemed more suitable for a synthetic solution (Lagrange with pyramids, Padula with his collection of simple plane and solid problems). The use of algebraic algorithms was seen as an expansion of the empire of analysis, the last of an impressive series of achievements by the universal language of the eighteenth century. In fact, Padula and the other analytics were not primarily geometers; they were engineers interested in different fields of pure and applied mathematics. What unified their various activities and pieces of research was precisely the faith in analysis as a universal method for any kind of problem-solving. Gino Loria remarked that Lagrange can be considered "the last representative of the unbounded confidence in the generality of formulas"[34]. Certainly that confidence was what his Neapolitan followers most admired.

1.3 The Last Challenge

We are now sufficiently equipped to return to the 1839 challenge. In that year the glove was thrown down by Vincenzo Flauti, former student of Fergola and professor at the RUN, perpetual secretary of the RAS, and member of a number of Italian and European academies. In April 1839, he published a pamphlet titled *Program Presented to the Mathematicians of the Kingdom of the Two Sicilies, to Promote and to Compare the Methods for Geometric Invention*[35]. In spite of such a "neutral" title this pamphlet sounded, to anyone interested in the sciences, like an evident provocation directed against the analytic school. Later on, Flauti wrote this note about the episode: "for the sake of ending the vain and boring debates about the prevailing of one method on the other in the geometrical invention, he [Flauti himself] proposed to his mathematician fellow-countrymen three geometrical questions"[36]. Naturally, Flauti was convinced that the "vain" debates could be ended by means of a decisive proof of the superiority of the synthetic method over the analytic one. The statements of three problems were presented for solution, introduced by a detailed historical account; the practice of introducing mathematical works with extended historical notes was indeed one of the distinctive features of the synthetic school. This allowed the reader to see a particular piece of work as inserted in the secular tradition of geometrical research, and to appreciate the historical stratification of results which were themselves part of the meaning of the problem. Indeed, in their attempt to revive the ancient tradition, synthetics described geometrical research as mainly related to the activity of problem-solving. This activity was not conducted in isolation but through inserting the new solution in the history of the problem, which usually started with the work of some Greek geometer and then continued through the history up to the present time. In dealing with such old problems, the synthetics were looking for new and more elegant solutions, but always "in the style of the ancients". This means that originality was not considered a relevant issue among the synthetics, who rather made the greatest effort to emulate the ancients. This also means that the same problem could constitute matter of investigation for centuries, without ever losing its intrinsic interest. The activity of the geometer is indeed a constant reflection on classical problems, which are both an unsurpassed didactic instrument and inexhaustible source of inspiration for the geometrical intuition of the researcher.

Flauti stressed that geometrical knowledge does not consist merely of the knowledge of geometrical truths, but also in mastering the different heuristic methods, "and in being able to evaluate their respective force, so to employ them properly"[37]. In the "Greek school" there was only one method he continued, but being deeply known and mastered it was in fact "a very powerful lever, that opened the way to many discoveries". In the ancient works, "geometry shows itself pure and without veils, so that the soul of the reader remains completely satisfied and enlightened"[38]. In the classical age, mathematical sciences advanced "with progressive augmentation", but always "by measured steps, which are peculiar to that method, a method used until Apollonius". The method of the Greek geometers eulogised by Flauti is what we earlier described as the twofold analysis-synthesis method. In particular, by stressing the mastery of the ancients, and the heuristic power of their lost techniques, Flauti is obviously referring to their geometrical analysis. The decline which took place after the generation of Apollonius, was a crucial moment in every historical reconstruction offered by members of the synthetic school: in the eyes of the synthetics the end of the classical tradition of problem-solving was indeed the most significant rupture in the history of mathematics. It coincided with the beginning of a long-lasting process of degradation of a previous corpus of knowledge which was virtually perfect and complete in itself. The loss of the great part of such a knowledge, including the technique of geometrical analysis, was never to be recovered. Flauti continued his excursus by describing the "Renaissance of mathematics" which consisted in the partial rediscovery of Greek texts by Italian mathematicians. The birth of "modern analysis" gave the moderns the advantage of possessing two different heuristic methods. The new method was "easier to learn, simpler, and more manageable [*maneggevole*]", and it provided the moderns with a surrogate for the lost techniques. New research conducted with modern analysis "had a real geometrical flavour, and it received from geometry light and confirmation"[39]. In this "very happy epoch" great mathematicians emerged in almost any country, and all of them studied and used both methods. Flauti depicted seventeenth century mathematicians as "always combining geometry with the analytic method, which was employed as instrument not as a goal in itself [*il principale*]"[40]. Calculus, mechanics, and every other branch of the mathematical sciences, both pure and mixed, were developed in strict contact with geometrical intuition, the real basis of any valuable progress. Which means that geometers using the Cartesian method joined the two practices of the algebraic-infinitesimal analysis and synthesis in a ideal manner. The important point is that, as Flauti remarked, although analysis did the greater part of the job, it always received "light and confirmation" from geometry. Troubles began in the first decades of the eighteenth century, when the mathematical sciences underwent a crucial "aberration from Geometry"[41]. The method "of the ancient schools" survived only in some universities, particularly in Great Britain and in Italy. Eventually, with the publication of the works of Lagrange, the "instrumental part" of modern analysis reached its highest technical development, whereas the "part depending on Geometry" went definitively out of the scene. In this way Lagrange, through the creation of a purely algebraic method to solve geometrical problems "dissolved geometry into analysis". According to the Lagrangian method, Flauti wrote, the solution of a geometrical problem is reached by "setting [*incastonando*] the data and the question in general formulas whose manipulation brings to the solving equation of the problem, without taking in consideration the figures"[42]. But, Flauti warned, often Lagrange didn't obtain these final equations "in a constructible form". On this "new analytic geometry" (*novella analisi geometrica*) that was developed by the French analysts Gaspard Monge (1746-1818) and Sylvestre Lacroix (1765-1843), Flauti prefers not to give any judgement, given that the value of the method was to be soon tested by the contenders. Nevertheless, a critical judgement clearly emerged from certain definitions he provided for the new method, such as "analysis reduced to combinatory art"[43]. The mechanical manipulation of formulas to which modern analysis is reduced, is seen as a poor surrogate of the once noble art of geometric analysis. Flauti supported his dislike of the new method by appealing to the main authority in recent Neapolitan mathematics, Nicola Fergola. Flauti noted how this esteemed scientist was worried about the new trend in the study of geometry, he quoted passages where Fergola criticised the "very new method", and he argued that the entire career of his master was indeed devoted to proving "how superior analytic geometrical method is with respect to the purely analytic method of the moderns"[44]. In fact, Flauti was attributing to Fergola a sort of radicalism which is absent in the writings of the founder of the synthetic school. Fergola, as we will see, was very competent in some branches of eighteenth century analysis, and his judgement on Lagrange had been rather different from the dismissive account provided by Flauti. I believe Flauti's interpretation of Fergola was essentially correct, anyway, as the foundational role of geometry with respect to analysis can be seen as the basis of Fergola's entire production. Flauti concluded by noting how Fergola's remarks were simply ignored by Neapolitan analytics: they produced purely analytical research in geometry, they wrote new textbooks, and they changed the way geometry had always been taught. In short, they made classical masterpieces look old-fashioned: Euclid and Apollonius were "reduced to ornaments for bookcases"[45]. Finally, Flauti came to the point:

> Given that we could not convince them by discussing openly on the value and the extension of the methods (this would presuppose the appropriate knowledge of the methods themselves) [...] and observing that mathematical sciences are every day declining in our country —even if somebody seems proud of certain hybrid advancements; we decided to renew the ancient system, that in the last two centuries was a great stimulus to the progress of mathematics[46].

It should be noted that Flauti saw his own age as an age of *decline* for the mathematical sciences. This was at odds with the perception of every mathematician outside the synthetic school, and certainly was at odds with the perception of the analytics, who celebrated the increasing applications of mathematical formalism to the physical sciences as a major success of recent mathematics. These are, in Flauti eyes, "hybrid advancements". Finally, Flauti accused the analytics of simply ignoring ancient geometry, an accusation which was returned by analytics who described Fergola and Flauti as unable to understand modern analysis.

Let us see now which kind of problems were presented by Flauti for solution:

1) Present the geometrical construction of the analytic solution given by Lagrange to the problem of inscribing in a given circle a triangle whose sides pass through three given points. Then present the analytical proof.

2) Inscribe in a triangle "given of kind and magnitude"[47] three circles, which touch each other and touch the triangle's sides.

3) Inscribe in a given triangular pyramid four spheres, touching each other and touching the faces of the pyramid.

Flauti gave three months time and guaranteed, at his own expense, a prize of sixty ducats for each question solved. The Mathematical Class of the RAS was charged with the assignation of the prizes. Prizes would be given to the authors of the solutions "that will be judged the more elegant"[48]. As in the tradition of the synthetic school, problems were not selected because of their originality, but rather because of their proven capacity of inspiring beautiful geometrical reasoning to a number of different mathematicians through the ages. *Nihil novi sub solis* in geometry, its practice being conceived as a never-ending intellectual reflection on classical problems. The first problem was a straightforward choice for Flauti. It was the famous "Problem of Cramer"[49], and it had been well studied, in its variants, by members of the synthetic school for the past fifty years; moreover, its solution was considered particularly difficult for the analytics. Flauti remembered that Euler himself had doubts about the possibility of reaching an elegant construction of the analytic solution given by Lagrange. Flauti also noted that Anders Johan Lexell (1740-1784) had failed to find such a construction. "Succeeding in this work" Flauti said, "would complete the research on a famous problem, which has been repeatedly solved and generalised in our school; and for which we still miss an adequate analytical solution"[50]. In fact, "after the light offered by the ancient geometry to this problem, a complete solution reached through modern analysis is still missing, given that the one by Lagrange is very imperfect"[51]. What was interesting for Flauti in this problem was the difficult passage from the final equation, obtained through the analytic method, to its construction. To sum up: Cramer's problem had been already solved in a series of very elegant ways by employing the purely geometrical method of the ancients (geometrical analysis plus synthesis); analysts, attracted by the fame of such a problem, presented analytical solutions for it; Lagrange himself presented at the Academy of Berlin a memoir on this problem; such analytical solutions did not include the construction of the solving equation, and those who had attempted its construction had found it quite hard to perform. Flauti was asking for such a construction, as he believed that the difficulty involved in this task would stress once again the intrinsic superiority of the synthetic approach to the problem.

Flauti found the second problem treated in a memoir from the 1831 volume of the Acts of the Academy of St. Petersburg[52]. Some time before, Flauti had asked one of his pupils, Nicola Trudi (1811-1881), to read and to report, with appropriate drawings, the content of the memoir. The point is that Trudi himself found a much more elegant synthetic solution for the same problem, which impressed Flauti (the original solution by Paucker was a geometrical one, but it made use of many lemmas, which violated the classical canons of elegance). The problem, which could be solved either in the analytic or in the synthetic way, was presented as one attracting the interest of many foreign mathematicians[53], "so that, without any doubt, it would be a great merit to solve it in a more elegant way". In this case, wrote Flauti,

> we ask for a solution obtained either with the method of the ancients (including the corresponding geometrical composition) or with Cartesian analysis, or, finally, with the very modern method of the two coordinates. We address this problem especially to the sagacious students of this very modern method, to assay its force and extension. But, in the second and third case, we also ask for an appropriate construction and proof, that must be obtained from the very principles and formulas used in the analytic part of the work[54].

In proposing this second problem, Flauti intended to directly compare the two methods. He believed that it would be hard to present an analytic solution which would result more elegant and direct than Trudi's synthetic one. The last problem, the one on the spheres, was "to our knowledge" a new problem, never faced by any mathematicians", and even this one could be solved by means of one of the three methods. Flauti conceived it as a natural extension of the second problem.

One might wonder why Flauti thought it was important to challenge his opponents at that particular moment. One reason is that criticisms directed at the synthetic school were rapidly growing, particularly in connection to didactic issues. A most significant episode in the analytic opposition to the synthetic *status quo* was the publication, in 1838, of a book titled *A Collection of Geometrical Problems Solved by Means of Algebraic Analysis*. The author was the young mathematician Fortunato Padula, who was completing his training at the School of Application for civil engineers. In this book Padula applied the Lagrangian method to solve problems of plane and solid geometry, and concluded by arguing for a more consistent employment of the calculus in descriptive geometry as well. The choice of the problems, and the reference to descriptive geometry (on which Flauti had written an influential synthetic treatise in 1807) made clear the polemic aim of the book. An appropriate reply was thus needed. Flauti, at that time the most representative member of the declining synthetic school, prepared the contest as such a reply.

Flauti's *Program* was published in April 1839. A few days later, on the 8th May 1839, in an anonymous note on the Neapolitan periodical *L'Omnibus*, it was pointed out that the third problem was indeed underdetermined. In fact, the same problem had already appeared at least three times on the *Annales de mathématiques*, and had been recognised as impossible to solve by Steiner already in 1826[55]. This was only the hint that a more effective attack against Flauti was forthcoming. In June 1839, there appeared the pamphlet *Reply to the Program* by Padula[56], containing a long introduction in which Flauti's ideas on methodology, didactic and history of mathematics were criticised point by point. Padula referred to Lagrangian methods in geometry as "analytical geometry" (sometimes "analytical geometry applied to two and three dimensions"[57]). With this term he meant that method by which "rather than considering the points and the triangles determining them, we consider the straight lines of which they are the intersections, and rather than consider the lines, we consider the planes and the surfaces containing them" so that geometrical problems can be "put in equation without any preliminary construction or figure" and "with the help of the forms of such equations, we proceed from the algebraic results to the more appropriate geometrical constructions" as Padula himself had shown in his 1838[58]. In solving this first problem, Padula started by "following the traces of Lagrange" and reaching the Lagrangian solving equation, which was "suitable for numerical calculation, and this being the goal he [Lagrange] always looked for, he didn't care to indicate the manner of proceeding to the graphic operations"[59]. But now Padula's goal is precisely "to geometrically determine the roots of this equation", that is to say to construct this second degree equation, which he did providing what in his own words was a "very elegant construction", as it contained a low number of graphic operations. It is more elegant, Padula remarked, than the one provided by Castillon using the purely geometrical method. Having done this, Padula went further "to prove the inexhaustible fecundity of algebraic methods"[60]. Starting again from the solving equation, he presented two other possible algebraic transformations of it, followed by the respective constructions. He wanted to show how it is easy to operate on the solving equation, to obtain from it elegant and straightforward geometrical constructions. "Of this kind of reasoning" Padula said, "which allow us to easily construct equations that at first sight seem to be very complicated, there are many examples in my *Collection*". Anyway, he continued, one should always remember that these operations are not required to put the problem in the form of an equation; they are only needed in the final construction of the equation, "and in this consists the great superiority of algebra over geometry"[61]. In the final remarks on the first problem, Padula observed that his constructions were more elegant and simpler than the ones obtained by means of geometrical analysis; and this "shows how very wrong is the one who judges of the elegance of the constructions obtainable from an equation on the basis of the length of the formulas"[62]. He was clearly referring to a passage from a collective work of the synthetic school where the complexity of Lagrange's solving equation was remarked, the difficulty of its construction being not attributed to "the great man", but to the "arte" (the analytic method)[63]. Finally, about the lack of response of the analytic school on Cramer's problem, Padula remarked that "mathematicians following the modern method" are not interested in this kind of research; in fact, in this particular case, for example, they are not attracted by the idea of finding a solution to the problem, because they would recognise as adequate the old synthetic solution provided by Castillon. At the same time, they are not interested in proving the "power" of algebra, "being themselves already persuaded of it"[64].

In August 1839, Flauti gave a speech at the RAS to report about the latest developments of the contest. He carefully avoided any reference to Padula's book. But, in presenting the list of the previous works on Cramer's Problem, he cited, for the first time, a paper published in 1818 by "one of our professors". This anonymous Neapolitan mathematician was Francesco Paolo Tucci (1790-1875), one of the oldest and more eminent exponents of the analytic school, and a teacher of Padula as well. Flauti could not avoid such references as Padula had given a very positive judgement of Tucci's work in his *Reply*, a couple of months before. Flauti's remarks were quite critical, instead. He considered this solution "almost identical" to Gergonne's (1816), and found that there are no connections between the analysis and the following construction "and this makes us suspect that he knew the construction before completing the analysis"[65]. In the same speech, Flauti praised the solution presented by Trudi. In fact, not only had Trudi provided the requested construction moving from Lagrange's work; he had also provided an alternative geometrical solution starting from Lagrange's principles and, finally, a "Cartesian" solution. Flauti said that this last part of Trudi's work was important because it showed the strict correspondence between Cartesian analysis and purely geometrical method, and the techniques to transform the steps of the one method into steps of the other (in this case it implied the transformation of some trigonometric formulas in corresponding geometrical properties). The point is that Trudi, knowing how "to properly treat geometrical matters", chose a way which was the most "appropriate to the nature of the subject"[66]. Moving from the trigonometric formulas that "entangle [*inviluppano*] Lagrange's analysis", Trudi established for any step a correspondence between formulas and geometrical quantities. This "natural way of reasoning" lead him to the desired construction and to the transformation of the analytic principles in geometrical truths, so that he produced a new, very elegant geometrical solution to the problem. Thanks to these efforts, Flauti continued, "analysis gave its own contribution to the study of this important problem"[67]. By keeping an eye on the geometrical figure "the sagacious Trudi" had overcame the usual problem of analysis, i.e. "the complexity of the solving equation"[68].

With his first problem Flauti did not intend to directly compare the problem-solving methods, given that he only asked for the construction of an equation. Still the formulation of the problem already presupposed the superiority of the synthetic method. Indeed, as we have noted in presenting Fergola's textbook, the very necessity of the construction of the solving equation only makes sense in a purely geometrical approach to problem-solving. So that while Flauti asked for the analytics to provide it, and criticised Lagrange for not considering the question at all, Padula stated that one of the great advantages of analysis over geometry is precisely that the final construction of the solution was no longer required. And if in his reply Padula presented such a construction, still he stressed that this was not necessary, because the problem is in fact successfully solved as soon as one get the solving equation. So even the apparently balanced remarks by Flauti on the productions relative to the first problem should be carefully considered. Flauti was very clear about the role of algebra in problem-solving: "it does not matter how much ingenuity one has, but with only the knowledge of geometrical analytic methods, he will never reach the proper solution of a problem"[69]. This can only be guaranteed by the study of the ancient texts, where we can find the twofold geometrical method in its most elegant form, elegance being defined, with Edmond Halley (1656ca.-1745), as "analysi brevissima et simul perspicua, synthesi concinna et minime operosa"[70]. But, Flauti observed, today our young mathematicians have a "corrupted taste", that makes them equally value any solution given to a problem, and sometimes they even consider as inferior the most elegant one, calling it "a mere school exercise" (these were indeed Padula's words). Moreover they did not consider the construction as an important part of the solution. The *Program* was planned to show this superior elegance to the corrupted young mathematicians. And to make clear that the "development of mathematics" depends on "those few ones who can be called inventors, and to the Academies, to which only those inventors have the right to belong"[71]. Trudi's work, Flauti said, was an example of an elegant construction of the problem according to the analytic method, and this for analysis is certainly "a great step"[72]. But, in the end, this was a step to "approach to the pure and clear geometrical method of the ancients"; this, and only this, remained the supreme model for geometers of all ages.

If the first problem was not designed to show a direct confrontation of problem-solving methods, the second did. Here the superiority of a purely geometrical solution over the various analytical solutions provided in the past is, in Flauti's eyes, evident. According to Padula, this was just another case where the superiority of the highly general analytical method can be shown. It can be useful to see again how the two different approaches shaped the form of the solution. Let us begin with the purely synthetic solution presented by Trudi (**Appendix 2**). Having stated the problem (P1), Trudi proceeds with a geometrical analysis of it (A1): he moves from admitting that the construction has been already performed, then he noted that the problem would be solved if we had a triangle similar to the given one and including the three circles; then he assumes an angle equal to one of the given triangle and inscribe a circle in it. The original problem can now be reduced to a new one (Trudi uses what Fergola had called the "principle of conversion"): that of inscribing two circles, under certain conditions, in the new figure (P2). The solution of this problem is preceded by the introduction of four lemmas (L1, L2, L3, L4), which are in fact four theorems which state some particular geometrical truth that is to be used in the solution of the problem. These particular lemmas state that certain relations hold between circles and their own tangents. Each lemma is proved by a synthetic demonstration (LD1, LD2, LD3, LD4) which consists of a construction performed on its own particular figure (F2, F3, F4, F5, F6, F7, F8). The demonstration of L2 is followed by three corollaries (C1, C2, C3), and that of L3 by one corollary (C4), which are results which immediately follow from the previous demonstration. At this point Trudi goes back to the problem P2, and states it clearly. The analysis of the problem follows (A2): again, it starts by assuming that the desired construction (the two circles) has been already performed. The consequences of this assumption are then investigated, with the support offered by the lemmas. After this second analysis, the problem is reduced to a third one (P3): it asks a certain point to be found that divides a certain segment according to a certain ratio. The analysis of the problem moves from the assumption of the point and then considers its implications, with the support of the lemmas. The analysis ends with the finding of the point. Trudi can now present the "composition" of the problem (S): here in a few steps he moves backwards from the construction the problem (P3) asked for; to the construction of the circles (P2) asked for; to the construction of the circles (P1) asked for, and with this result the problem is finally solved. In his brief comment on this problem, Trudi remarked that, in this case, the key idea was that of using the principle of conversion: this technique is indeed "the more suitable to its nature [of the problem] and the more effective in order to show a priori how many and which ones are the positions the three circles can take in order to satisfy the conditions"[73]. Flauti, in his own remarks, stressed the same point. "This solution" he said, "consists of a brief and plain analysis, founded on a simple conversion of the proposed problem"; he notes that "it only needs four geometrical truths" (the lemmas), and that the final construction was "easily" performed. All this means that such a solution has "a very great elegance". A further quality is that this analysis showed "by intuition" the possible solutions for the problem in its more general form, that involving three straight lines and three circles[74]. Reporting on this solution in his speech of August 1839, Flauti stressed that this geometrical solution provided new and important truths. The point is that, in solving problems, geometry always provides some new acquisition of knowledge, even if, in the end, the attempted solution should remain incomplete, "and this isn't an insignificant advantage of the geometrical method; whereas, and that is for sure, purely analytic research doesn't gain anything if it doesn't get the final solution"[75]. Flauti also made some interesting remarks about the choice of this second problem. He says that he preferred not simply to publish Trudi's solution, because, in this way, no attention would be given to it. This is because "some of us, jealous and afraid to be surpassed, or beaten in obtaining new appointments, or for mere incompetence, would have defined such work, without even having read it, as a *mere school exercise*"[76]. Flauti recognised that the "simplicity" of Trudi's work, which was a value in the synthetic school, was the reason for the lack of interest by the analytic geometers.

Let us now move to the solution presented by Padula (**Appendix 3**). He starts by expressing all the conditions of the problem in algebraic form. In order to do this, he chooses an appropriate system of coordinates (the one centred in A), then he expresses the position of some interesting points (such as O, A',M, M', M'', that is those points whose knowledge would immediately lead to the solution of the problem) with respect to the chosen system. On the basis of the figure, he finds that certain relations holds among these points, relations that can be expressed by three couples of equations, that he calls (1), (2), and (3). Having expressed all the conditions of the problem in the algebraic form Padula begins to combine the equations "in every possible manner", in order to obtain the values of the coordinates of the circles' radii (which he calls: u, u', u''). He begins with the first equation of each couple where, "following the general norms of Algebra", he eliminates the radicals and introduce the unknowns (x, x', x''). After such substitutions, the equations (1), (2) and (3) are transformed in, respectively, (4), (5) and (6). Padula notes a relation between two of his earlier unknowns (7), so that he can operate the relative substitution in (6), re-order the equation and then operate another substitution from (5). Padula re-orders again, eliminates certain coefficients, and substitutes from (4), obtaining the three equations in x. He solves them and then from the values of x, x', x'' obtains the values of u, u', u'', and from them it is possible to deduce the length of the segments on the basis of which it is possible to construct the required figure, which is actually done in the final composition of the problem. At the end of the work, that is presented as another example of the superiority of the analytic method, in that it permits everyone to reach without particular intuitions every possible solution, Padula refused to provide the "*convenient proof*, on the basis of the formulas employed in the analysis"; one doesn't need any proof, said Padula, given that an equation necessarily has to be satisfied by its own roots. In confronting the two methods, Padula remarks that even when a problem has many solutions, not all of them reciprocally independent (as is this case), the algebraic method guides us, without requiring any particular attention, to certain equations that can be decomposed in other equation of lower degree and then combined to obtain all such solutions. On the other hand, the geometrical analysis of the ancients, which proceeds through reasoning on the specific disposition of the elements of the figure, is not able to consider all the possible solutions by means of a single mental operation. In this case, the geometer has to imagine the different reciprocal positions that can be assumed by the elements, and then to proceed to the particular analysis. And, one has to admit, that in this way no one can be sure of reaching a priori all the different solutions of a given problem. Padula closed his reply by showing that the third problem is underdetermined. One could solve the family of problems deriving from the original terms, but "let this work be accomplished by those who like to solve problems that are similar [*affini*], we are not interested". In fact, "we consider researches in pure Geometry as beautiful tokens, but too sterile and uninteresting for those who have completed the elementary courses and are interested in research". In fact, anyone who is seriously interested in contemporary mathematics should look at the applications to "Natural Philosophy, Constructions, Industrial Mechanics" where new works are, every day, expanding the body of mathematical knowledge "in such a way that is almost impossible to be informed on everything"[77]. This is why, Padula announces, he will never discuss again the advantage of the Lagrangian method in the case of some particular problem.

Padula's reply was considered irregular. The prizes, after some inconclusive discussions at the RAS, were assigned to Trudi, but he refused because, he said, he had been previously working on the same questions. In the end, the whole contest came to nothing. If anything, it confirmed once more that the outcome of the controversy could not be decided by any clear-cut solution. Flauti intervened again in the controversy a few years later, in an essay he wrote as an introduction to

Fergola's *On Geometrical Invention*. Here Flauti recognised the generality of the methods employed by the analytics (Cartesian or Lagrangian), but in his mind it is precisely this generality that makes the analyst "a mere compiler [*compilatore*] of algebraic formulas"; someone essentially different from the "true inventing geometer [*vero geometra inventore*]"[78]. Certainly, Flauti says, research follows the same principles in both methods: one supposes given what is actually requested in order to solve the problem, and then one finds the "determinants" of this supposition. But, Flauti says, this research can be performed following either a "direct" way, and this is the "synthesis, as we call the method of invention used by the ancients", or an "indirect" way, i.e. "using the Cartesian method, or any other derived algebraic method". Here "direct" and "indirect" seem to refer to the conceptual distance of each method from the essential geometrical reasoning which lies behind every "proper" solution. Flauti also notes that in the direct way, "a great amount of knowledge [*un grandissimo treno di conoscenze*]" is required, this "*arte*" being "difficult, and really sublime"[79]. On the contrary, in the indirect way, once one has found the solving equation, "the whole of the art of the geometer is reduced to the mere use of general rules"[80]. Flauti's tone, when he is dealing with the question of methods, is different from Fergola's. Where Fergola had been a productive analyst himself in the early stages of his career, had worked in infinitesimal and integral calculus, and had always used algebraic tools in his geometrical teaching and research, Flauti had been working exclusively on pure and descriptive geometry. Fergola's teaching had brought him, as many other of his colleagues, to admire unconditionally the work of Greek geometers and, eventually, to reject the very use of algebraic formulas in problem-solving. Even when he tries to be equal, as in this introduction to Fergola's book, Flauti's deep dislike for algebraic methods invariably emerges, as his devaluation of the work of Lagrange and of the analytics. Still, when it comes to the reasons of his dislike, he does not present any original insight with respect to Fergola. So we find him maintaining typical Fergolian points such as the crucial role of construction in the problem-solving process: "the construction is the essential condition for a geometrical problem to be properly solved; in fact, every ancient and modern geometer defined a problem as something *in quo aliquid faciendum, et construendum proponitur*"[81]. Algebra, he continues, has to remain an economical device, given that, in the end, a proof has to consist in "a clear succession of geometrical reasonings executed on geometrical quantities"[82]. This time no one, on the other side, was interested in replying. The controversy was a matter of history.

1.4 Epilogue

The 1839 challenge came to nothing. Rather than being "solved" either way, the controversy became increasingly irrelevant until it slipped out of the scientific stage in the early 1840s. As noted at the beginning, the very reason to oppose the different methods is far from obvious to us. Truly, one might understand the point of view of the analytics, i.e. their search for very general methods and their wider interests in pure and applied mathematics. But, at the same time, one can hardly sympathise with their harsh criticisms of pure geometry, which they considered inelegant and pedantic, and unworthy of figuring in scholastic and university curricula. Yet this controversy caused struggles, hostilities and personal attacks in early nineteenth-century Naples. It was also rich in consequences. Indeed, its consequences for the development of mathematics in unified Italy are probably more important than is usually thought. Even after the political unification of Italy (1860), Southern mathematicians who had been educated in the atmosphere of the controversy over problem-solving methods, continued to pursue their own anti-Euclidean battle, to the puzzlement of their Northern colleagues. As an example of such a long-lasting effect of the controversy, we can think of the debate about the possibility of introducing Euclid's *Elements* in the *licei* (colleges where classical education was provided) of the newly founded Kingdom of Italy. In 1867 important decisions about the future structure of Italian schools were taken by specific state commissions. In geometry, the adoption of Euclid was proposed as the best way to immediately provide a common mathematical textbook to replace the many different institutions used in the pre-unitary states. Euclid, it was also said, "is in the universal opinion the most perfect model of geometrical rigour"[83]. But, for all its reasonableness, the project found strong opposition among the contributors of the newly founded *Journal of Mathematics*, directed by Giuseppe Battaglini (1826-1894)[84]. Trained as an engineer at the Neapolitan School of Application under Padula's supervision, Battaglini had been excluded from university teaching until the collapse of the Bourbon monarchy and of its educational system. In 1860 he had been appointed a new chair of "superior geometry", while Flauti, who had retired from teaching in 1849, was refused a place in the restored Academy of the Sciences, and the very memory of the synthetic school was rapidly going into oblivion. Battaglini became well-known in the national scientific world because of his commitment to the study and diffusion of non-Euclidean geometries. In fact, major original contributions to this field (such as Beltrami's, in 1868), as well as important translation of foreign works (Bolyai, Lobachewski), appeared in Battaglini's journal. The reasons why the introduction of good old Euclid was opposed by Battaglini's generation of Neapolitan mathematicians were not obvious to their colleagues. Having described the synthetic commitment to classical geometry, we are able to see that this opposition was in many ways a prolongation of the long-lasting struggle of their teachers against Fergola's school. Although in a very different institutional and cultural context, once again the priority of pure geometry and the exemplary character of geometrical reasoning had been stated. The value of Euclid as a textbook ("the most logical and rigorous [geometrical] system we have"[85]) was authoritatively defended by Antonio Cremona (1830-1903), who lead the specific commission where the decision to introduce Euclid had been taken. Cremona was to become a distinguished geometer, whose contributions were to be particularly important in the fields of birational transformations, graphic statics and projective geometry. According to Cremona, whose views were supported by other important mathematicians of the period such as Betti and Brioschi, the role of mathematical education in colleges was not limited to provide a set of truths *per se*, and not even a set of useful truths to be applied in everyday life; rather, this role consisted in supporting the intellectual development of the pupil, "as a gymnastic of thought, aiming to develop the rational faculty, and to support that healthy and right criterion to distinguish the truth from what simply looks true"[86]. In the text of the decree prepared by the commission, pedagogical considerations ("when it is taught with the method of the ancient, geometry is easier and more attractive than the abstract science of numbers"; the Euclidean method "is the most proper to create in young minds the habit to inflexible rigour in reasoning") are mixed up with interesting remarks about preserving the "purity" of geometrical reasoning. Teachers should not "pollute the purity of ancient geometry by transforming geometrical theorems in algebraic formulas, that is by replacing concrete magnitudes (lines, angles, surfaces, volumes) with their measures: but [they should] make their pupil always reason on former, even when their ratio is considered"[87]. It has been noted that "the theme of the purity of geometrical method was very much stressed", and that Cremona "was aware of the new dignity of geometrical methodologies, which had been overshadowed, during the eighteenth century, by differential calculus"[88]. Prefacing their edition of the *Elements* (November 1867), Betti and Brioschi presented similar arguments: the *Elements* as "inimitable model of logic and clearness" (as opposed to "the mechanism of arithmetical process"); its importance as a textbook for college students (as opposed to textbooks for teaching mathematics with "a professional aim").

As we can imagine, Padula's pupils could not be expected to agree with such views. In response, Battaglini's journal hosted a few articles which were critical towards the new didactic choice. Among them, pieces by J. M. Wilson, Hirst, Houel, and the Neapolitan Raffaele Rubini, another of Padula's pupils and himself a strong opponent to Euclid as a textbook. The experience of other countries, the logical difficulties implied by the notion of proportion, the error of setting geometry apart from arithmetic, the well-known obscurities contained in Euclid's text, were employed to attack the governmental choice. In their reply to such criticisms (letter to *Giornale* of 1869) Betti and Brioschi were, first of all, surprised by the "intolerance" of their adversaries.

As we can see it would be possible to shift without loss of continuity from our analysis of the Neapolitan controversy to other important issues in the post-unitarian Italian mathematics, such as the adoption of Euclid as a textbook and, more generally, the role of mathematics in the educational system of the new state. And such a topic cannot be properly addressed without considering another crucial point: what was the role of mathematicians themselves in the foundation of the new state? In fact, in the 1860s and 1870s, an unprecedented number of mathematicians entered political life, and contributed to the design of the new Italian cultural institutions. What was their legacy? Such an analysis would clearly exceed the limits of the present work. For our present purpose, it is sufficient to note that the Neapolitan controversy over methods was not as isolated and peculiar as we might expect from a superficial historical account. In particular, it was not so devoid of consequences as later historiography has suggested, by presenting the synthetic school as a curiosity, a scientific blind alley, or by simply eliminating its very memory. The historical irrelevance of the synthetic school can now be seen largely as a reflection, at the historiographic level, of the judgement expressed by those who had opposed Fergola and Flauti. the very history of the historiography of the controversy would constitute an interesting case study in itself.

Let us return to the historical material that has been presented so far, in order to add a few remarks about concepts which can be used to describe the controversy. We defined the two approaches to problem-solving as "specific" and "general". In fact, other pairs of opposites, all in some way related each other, can be employed to (schematically) define the two positions. The Neapolitan controversy can be seen in terms of **locality** and **generality**, i.e. between a conception of mathematics which privileges the consideration of local conditions and a conception which privileges the consideration of general conditions. As we have seen from our first example, these are two kinds of knowledge which cannot be contemporaneously achieved: a choice is required. So if we decide to solve problems by means of accurate inspections of particular figures it will be very difficult to move towards the highest levels of generality; if we decide to solve problems by means of manipulation of general formulas, it will be very difficult to acquire specific knowledge of the particular figure under consideration. Far from considering such a choice as a matter of convenience, Neapolitan geometers charged it with a crucial value: either one or the other approach should be the fundamental one, they thought, and the knowledge whose achievement is made difficult by such an approach must be regarded as unessential. In the synthetic practice of problem-solving the preliminary construction sets the stage for the whole problem-solving process. The geometer is here reasoning on a particular figure, in order to perform a particular construction. Certainly he is interested in generalising his reasoning to include other classes of figures and other possible dispositions (this is especially evident in the work of Fergola), but synthetic and Cartesian methods only allow a low level of generality. In the end, the solutions provided are derived from the particular case, maybe with some possible extensions (for instance, the geometer provides a solution not only for the specified case, let us say a triangle, but he also generalises his result to the case of a polygon). The analytic practice goes, so to speak, in the opposite direction. In its purest form (Lagrange) it starts from the very general, i.e. the construction of sets of equations which can be seen as expressing metric properties of entire classes of figures, and from these equations solutions to problems are derived. In the way Padula used it to challenge the synthetic school, this method is applied to particular problems of the kind studied by synthetics, but still it allows a much higher level of generalisation, and in the end it offers a higher number of possible solutions. Clearly problem-solving played a very different role in the activity of the two schools. In the synthetic conception problem-solving is essential; it is the starting point of every geometrical research and the necessary prelude to any systematic account of certain geometrical truths. A geometer is a problem-solver; problem-solving is the way in which he discovers geometrical truths. In the analytic conception problem-solving in the sense in which this activity is conceived by synthetics, i.e. problems asking for specific constructions, is a decidedly secondary activity. Lagrange simply ignored it; Padula solved such kind of problems because of the controversy, but finally he also declared his lack of interest (1839). The solution of specific problems can be seen as a secondary product of that algebraic reasoning which *in itself* is the real core of the activity of the analytic geometer.

The conceptual couple locality/generality can be fruitfully related to the one **concreteness/abstractness**. The synthetic geometer confines his considerations to the local dimension of geometry; he deals with concrete entities, the particular geometrical figures. He inspects, compares, cuts, draws concrete figures. Certainly he would say he is dealing with "geometrical abstractions"", as he is respectful of the Aristotelian-Thomistic tradition; he would say he is not considering *this* particular triangle, but rather what is typical of every possible triangle. But this does not affect our considerations about his being restricted to the local and concrete dimension of geometry. In his mind geometry is an abstract science because it does not depend on any particular instances. Still, once such an abstract nature of geometry is stated, his practice appears centred on the scrutiny of particular, "typical" figures. The art of the geometer is indeed described by synthetics in sensorial terms, mainly visual. The geometer *sees* that a problem can be reduced to another one; he *sees* which are the possible solutions to a problem; he *sees* that a certain solution can be constructed in a certain way. In this sense I would say that the practice of the synthetic is concrete: he is looking at and acting on particular figures. Synthetics themselves considered this point as crucial, as we know from their criticisms directed against the abstract reasoning of the analytics. The whole argument against the reliability of analysis in problem-solving depends on an alleged lack of concrete content. How can we know, synthetics say, that the analyst is actually saying something geometrically meaningful with his formulas, if these are not directly related to the figure? Formulas alone, notes Flauti, are "abstract" in the sense that they lack intuitive content. Indeed, switching to the epistemological dimension, the visual processes by which the geometer acquires his knowledge are said to be "intuitive" by synthetics, as opposed to the "mechanical" processes by which the analyst acquire his knowledge.

Intuition / mechanicity is indeed another couple which can be used to capture important aspects of the controversy. Flauti underlines that in his solution to the second problem of the challenge Trudi has found "by intuition" the possible solutions. Inspection of the figure, plus experience, plus natural inclination are required in order to obtain such a sagacious solution. On the contrary, Padula says that "anyone can solve problems" once he has grasped the "spirit" of the analytic method: and this is possible precisely because no special intuition is required, just the ability to calculate (so, according to Lagrange, "every problem reduces to a matter of calculation"). And calculation is presented as a mechanical process, which only needs the right inputs to provide the right results. To solve problems the analyst has no need to *see* anything, nor to rely on his own intuition. He has simply to follow the general and universal rules of algebra. From an epistemological point of view, the analyst and the synthetic are in fact referring to *different faculties* when they describe their problem-solving procedures. So Fergola and Flauti call the art of discovery and the art of demonstration "dianoethic virtues", and they think of them as a form of intellectual intuition (in fact the highest achievement of human intellect). Padula simply compares his method to a mechanical process. These epistemological considerations provide us with some of the reasons behind the synthetics' caution in using algebraic tools in problem-solving. According to them geometry, which is "the science of extension", is founded on our intuitive knowledge of the properties of abstract forms. Algebraic reasoning is valid in geometry as far as it brings intuitive geometrical content, which is the case in the

Cartesian method. When the problem's solution is detached from any intuitive consideration about figures, algebraic formulas are simply void, meaningless. At least, they are not talking about geometry. On the other side, the analyst believes algebraic formulas are in themselves a powerful instrument to analyse and solve any kind of mathematical problem. The solution of a particular problem does not depend on some specific intuitive knowledge, but rather on the general form of reasoning that we adopt. This general form of reasoning is that of analytic reasoning. This is a problem-solving procedure that, whatever the field of application is, provides the analyst with the desired solution.

Let us finally consider the explanations that historians have provided in order to make sense of the Neapolitan controversy. Federico Amodeo, in his valuable work on the history of Neapolitan mathematics, did not go much further than the recognition that there are mathematicians who are "synthetically minded" and mathematicians who are "analytically minded"[89]. Everyone just follows his own natural inclination. An explanation which reminds us too closely of the *virtus soporiphera* of opium to be satisfactory. In the only historical work specifically devoted to the Neapolitan synthetic school (1892), Gino Loria presented Fergola's project as desperately anachronistic. In spite of their "excellent quality", Fergola's geometrical textbooks "have fallen in oblivion" because of their attempt to "revive a corpse", i.e. Cartesian geometry. There was no space for Fergola's creature "in the new state of things"; thus the failure was an "ineluctable fatality"[90]. The controversy with the analytics is consequently presented as due to the "backwardness" of Fergola and his school. Interestingly, Loria applies to the history of mathematics the epigenetic metaphor, claiming that it was possibly necessary for Neapolitan science to pass through the "Cartesian stage", represented by Fergola. But he also noted, with his distinctive macabre gusto, that Fergola's program "contained in itself a deadly germ which brought it to the grave", so that his geometry was, by the early 1840s, "a putrefying corpse"[91]. The theme of backwardness returns in other historical judgements, such as Vito Volterra's, who in his survey of nineteenth century Italian mathematics remarked that in Fergola's school "men who were otherwise ingenious opposed Lagrange's great discoveries and what was modern and new in science, considering a valuable task that of setting [science] back a number of centuries"[92]. More recently, Massimo Galluzzi has presented an analysis of Fergola's school, where its restoration of the "dignity of geometry" is placed in the wider context of the European flourishing of geometrical studies during the first half of the century. The specific fact that the Neapolitans favoured the classical geometrical methods is explained by the limited opportunities they had to actually get in touch with the mainstream of mathematical production at the end of the eighteenth century, and by the highly "anti-scientific environment" that surrounded their school. According to this argument, the classics being "the only scientific education he received", Fergola trained a generation of pupils who were to obstinately defend Greek geometry against Lagrangian analysis[93]. The controversy over methods is explained as a confrontation with a group of younger and better "informed" mathematicians. Finally, in a recent study on Nicola Fergola, Giovanni Ferraro and Franco Palladino have argued, on the basis of manuscript material, that the geometrical turn of Neapolitan mathematics was a responsibility of Fergola's pupils, of Flauti first of all[94]. As for Fergola, he was instead deeply interested in analysis, particularly calculus in its Eulerian and Lagrangian form. The controversy with the analytics was entirely due to his pupils, and it is considered as scarcely relevant for the history of science, as it is reducible to extra-scientific causes, primarily to the political divergence between the two groups of scientists[95].

Explanations of the controversy are essentially based on the unproblematic recognition of the "backwardness" of the mathematical knowledge produced and transmitted by the synthetics, possibly related to the alleged cultural isolation of the Kingdom of Naples. Such an interpretation can be convincingly refuted on the basis of some simple empirical considerations. First of all, the ages of the protagonists: two generations of mathematicians were involved in the controversy, and they were more or less of the same age (if Flauti speaks of "young analysts", it is because he mainly refers to Padula's works; but Padula's teachers were of the same age as Flauti himself). Secondly, and more importantly, we do not find traces of an old, pre-existent synthetic school, which was later challenged by some innovative researchers. On the contrary, the consolidation of the synthetic school took place *contemporaneously* with the introduction of the analytic methods in the Kingdom of Naples, and the debate on methods had a constitutive role in the definition of the school itself. The connection with the previous traditions, with the works of previous Italian and European geometers, which we find in synthetic writings, was mainly the result of an operation we might call "inventing a tradition". The role of custodians of a venerable tradition was in itself part of the new image of mathematics sustained by Fergola. Thirdly, it will be shown that Fergola was far from being incompetent in the analytic methods, and that he was familiar with Lagrange's writings.

Undoubtedly, we have to look for a more satisfactorily explanation for the emergence of the synthetic school and for the controversy over methods. This explanation should first of all problematise what has always been assumed as unproblematic, i.e. Fergola's "backwardness". Far from casting light on the controversy, the appearance of backwardness is, indeed, what is most in need of an explanation. A first step in this direction is that of showing how Fergola's specific position about geometrical methods depended on a wider strategy of his, which was essentially a foundational strategy, and which included interesting considerations about the possibility of offering a sound (geometrical) basis for infinitesimal calculus. The discovery of such internal coherence in Fergola's thought and practice is certainly an advancement with respect to previous interpretations of the controversy, and even judgements about Fergola's historical relevance; yet, it is still not enough to understand why it was that Naples provided the site for the emergence of such a peculiar (anachronistic, in fact) Greek-like geometrical movement. To this extent, the birth of the controversy, the main works of its protagonists, and the cultural and social environment that surrounded these early productions will be analysed. It will be suggested that only broader cultural and social considerations provide us with a satisfactorily explanation of the Neapolitan controversy.

Notes to chapter one

[1] Public challenges between mathematicians were not uncommon in Italy during the Renaissance. These contests could have the form of *cartelli*, i.e. exchanges of letters containing problems to solve, so that each one of the duellists had to solve the problem proposed by the opponent. Or they could be public duels, in which a problem had to be solved in front of an audience. Particularly famous was the opposition between Niccolò Tartaglia and Gerolamo Cardano, in the sixteenth century. The dispute, about the general method of solving cubic equations, led to a public challenge between Tartaglia and Lodovico Ferrari (Cardano's disciple), which took place in a church of Milan, in Summer 1548. On this episode, see

Arnaldo Masotti (ed.), *Lodovico Ferrari e Niccolò Tartaglia. Cartelli di sfida matematica* (Brescia: Ateneo di Brescia, 1974).

[2] The official denomination of the kingdom after the Restoration was "Kingdom of the Two Sicilies", beecause it included both the former Kingdom of Naples and the former Kingdom of Sicily. In the following, we will employ the denomination "Kingdom of Naples" even when referring to the Restoration age.

[3] See, for instance, Vincenzo Flauti, *Elogio storico di Nicola Fergola* (Naples: 1824) p.16, on the "universal corruption" of geometrical methods.

[4] Marco Panza, "Classical Sources for the Concepts of Analysis and Synthesis", in Marco Panza and Michael Otte (eds.), *Analysis and Synthesis in Mathematics. History and Philosophy* (Dordrecht: Kluwer, 1997) pp.367-368.

[5] See *Odissey*, β 104-105, and τ 149-150.

[6] See Aeschylus, *Prometheus Bound*, 460.

[7] Panza and Otte, introduction to *Analysis and Synthesis in Mathematics*, pp.ix-xi.

[8] See Wilbur Knorr, *The Ancient Tradition of Geometric Problems* (New York: Dover, 1993); and David Fowler, *The Mathematics of Plato's Academy. A New Reconstruction* (Oxford: Clarendon Press, 1987).

[9] Knorr, *The Ancient Tradition of Geometric Problems*, p.110.

[10] One should not think of theorems and problems in the ancient tradition as two essentially different kinds of mathematical object. The very same mathematical truth could indeed be expressed either in a theorematic form, as a statement to be proved, or in a problematic form, as the solution to the quest for a certain construction to be performed. Consequently, the proportion of theorems and problems to be included in a text of geometry was a matter of choice, and it depended on the specific goals of author.

[11] For this interpretation of the work of later commentators see Knorr, *The Ancient Tradition of Geometric Problems*, chapter eight.

[12] See Michael Mahoney, *The Mathematical Career of Pierre de Fermat* (Princeton: Princeton U.P., 1973) chapters two and three.

[13] Nicola Fergola, *Dell'invenzione geometrica* (Naples: 1842). In this context, the Italian term "invenzione" (invention) was employed to mean "discovery"; such an old-fashioned use of the term echoed the Latin "inventio" (from the verb "invenio"), and reflected the logico-philosophical tradition, where the *ars inveniendi* was opposed to the *ars demonstrandi*.

[14] The problem is extracted from Fergola, *Delll'invenzione geometrica*, pp.198-199. Minor changes have been introduced with respect to the original notation.

[15] Fergola, Dell'*invenzione geometrica*, p.199.

[16] Ibidem, p.193.

[17] Ibidem, p.194.

[18] Ibidem, p.196.

[19] The discovery of the proper methods for geometric invention was accomplished by Fergola with an "infinite effort" (Flauti, *Elogio storico di Nicola Fergola*, p.11).

[20] Fergola, *Dell'invenzione geometrica*, p.239.

[21] Idem.

[22] Particularly influential was Lagrange, "Solutions analytiques de quelques problémes sur les pyramides triangulaires"; another usual reference was Joseph-Luis Lagrange, *Méchanique analytique* (1788), in *Oeuvres*, vol. 11 (Paris: 1888).

[23] Lagrange, "Solutions analytiques", p.661.

[24] Ibidem, p.662.

[25] Fergola, *Dell'invenzione geometrica*, pp.194-196.

[26] On the practice of constructing equations, which yielded line segments with length equal to the roots of the equation, see Henk Bos, "Arguments on Motivation in the Rise and Decline of a Mathematical Theory: The Construction of Equations, 1637-1750ca.", *Archive for the History of Exact Sciences*, 1984, 30:331-380. Bos linked the decline with the general shift from a geometrical to an analytic conception of mathematics, and placed its disappearance

around 1750. The reinstatement of this practice was part of the Fergolian restoration of the supremacy of geometry over analysis.
[27] Fergola, Dell'*invenzione geometrica*, pp.245-248.
[28] Ibidem, p.245.
[29] Fortunato Padula, *Raccolta di problemi di geometria risoluti con l'analisi algebrica* (Naples: 1838) p.13.
[30] Ibidem, p.145.
[31] Ibidem, p.146.
[32] Idem.
[33] Lagrange, "Solutions analytiques", p.692.
[34] Gino Loria, *Storia delle matematiche*, vol.3 (Turin: 1933) p.256.
[35] Vincenzo Flauti, *Programma destinato a promuovere e comparare i metodi per l'invenzione geometrica presentato a' matematici del Regno delle Due Sicilie nell'aprile 1839*, pamphlet reprinted in Vincenzo Flauti, *Produzioni relative al programma di tre quistioni geometriche proposto da un nostro professore* (Naples: 1840) pp. 3-16.
[36] Vincenzo Flauti, *Prospetto di mezzo secolo di servizi* (Naples: 1849) p.20.
[37] Flauti, *Programma*, p.3.
[38] Ibidem, p.4.
[39] Ibidem, p.5
[40] Idem.
[41] Ibidem, p.6.
[42] Idem.
[43] Ibidem, p.7.
[44] Ibidem, p.9.
[45] Ibidem, p.10.
[46] The Tuscan mathematician Vincenzo Viviani (1622-1703), the last of Galileo's pupils, used the same expedient (a challenge) to counter the rise of Cartesian analysis. Flauti, willing to connect himself with this well-known precedent, remembered Viviani's proposal, where he offered for solution an "enigma geometrico, ut hinc, qui temere contumelias in Geometriam jacere audent, silere discant, vel potius cum maxima voce exclament: Oh! unica verorum sciscitabilium scientia a Divina in hominum mentie infusa, ut haec imperviis, mutabilibus, fallacibusque contemptis, aeterna ista, quae sempern et unicuique sunt eadem, tantum appetat, nihilque aliud unquam magis innocuum scire perquirat" (Flauti, *Programma*, p.10).
[47] That a geometrical figure is "given of kind" means it has to be similar to a given figure (in this case a given triangle).
[48] Flauti, *Programma*, p.16.
[49] The problem, known originally as "problem of Castillon", was proposed in 1742 by the Swiss Gabriel Cramer to the Tuscan mathematician Giovanni Salvemini (1704-1791; called "Castillon" from his birthplace). The problem appears originally in Pappus, but with the restriction of the co-linearity of the three points. Castillon presented a solution for this problem in 1776, at the Academy of Berlin; Lagrange, who attended the presentation, himself presented an analytic solution. In Flauti's mind, Lagrange had reached the solving equation of the problem "but in an incomplete way", i.e. "writing in a shortened form the expression that make this equation very heavy [*greve*], and than he stopped there, without completing the solution of the problem" (Vincenzo Flauti, "Considerazioni generali su tre difficili problemi e sul modo di risolverli", in Flauti, *Produzioni*, p.30). Flauti pointed out the same imperfection in every other successive analytical solution to the problem, including that given by Simon Luhilier for the case of any polygon. To this generalisation, Flauti opposed the one reached by Annibale Giordano "using the method of the ancients".
[50] Flauti, "Considerazioni", p.12.
[51] Ibidem, p.33.
[52] Magnus Georg von Paucker, "Mémoir sur une question de geométrie relative aux tactions des cercle" (1831); see Flauti, "Considerazioni", p.45.

[53] Flauti referred to Northern Italian Gianfrancesco Malfatti (1731-1807). In fact, this second problem was also known as "problem of Malfatti", because he provided a solution for it in 1802. The problem interested also J.Bernoulli, Gergonne, Steiner and Clebsch.
[54] Flauti, *Programma*, p.13.
[55] See references in Loria, *Nicola Fergola*, pp.115-116.
[56] Fortunato Padula, *Risposta di F.P. al programma destinato a promuovere e comparare I metodi per l'invenzione geometrica presentato a' matematici del Regno delle Due Sicilie* (Naples: 1839).
[57] See, for instance, Padula, *Risposta*, p.xxvi.
[58] Padula, *Risposta*, pp.xxix-xxx.
[59] Ibidem, p.2.
[60] Ibidem, p.7.
[61] Idem.
[62] Ibidem, p.12.
[63] *Opuscoli matematici della scuola del sig. Fergola, parte già pubblicati e parte inediti,* (Naples: 1811) p.23.
[64] Padula, *Risposta*, p.15.
[65] Flauti, "Considerazioni", p.34.
[66] Vincenzo Flauti, "Storia e vicende del programma", in Flauti, *Produzioni*, p.15.
[67] Flauti, "Considerazioni", p.34.
[68] Ibidem, p.35.
[69] Ibidem, p.20.
[70] Ibidem, p.21.
[71] Ibidem, p.19.
[72] Ibidem, p.37.
[73] See in Flauti, "Storia e vicende del programma", p.28.
[74] Ibidem, pp.44-45.
[75] Ibidem, p.47.
[76] Ibidem, p.viii.
[77] Padula, *Risposta*, p.46.
[78] Flauti, preface to Fergola, *Dell'invenzione geometrica*, p.xvii.
[79] Ibidem, p.v.
[80] Ibidem, p.xxiii.
[81] Ibidem, p.xxiv.
[82] Ibidem, p.xxvi.
[83] Quoted in Luigi Besana and Massimo Galluzzi, "Geometria e latino: due discussioni per due leggi", in Gianni Micheli (ed.), *Storia d'Italia. Annali 3: Scienza e tecnica nella cultura e nella società dal Rinascimento ad oggi,* (Turin: Einaudi, 1980) p.1292.
[84] The complete title was *Giornale di matematiche ad uso degli studenti delle università italiane, pubblicato per cura del prof. Giuseppe Battaglini,* and it was published in Naples by the editor Benedetto Pellerano. The journal, which was soon to become one of the most important Italian mathematical journals, was informally referred to as "Giornale di Battaglini".
[85] Quoted in Umberto Bottazzini, *Va' pensiero. Immagini della matematica nell'Italia dell'Ottocento* (Bologna: Il Mulino, 1994) p.146.
[86] From the 1867 decree, probably by Cremona's hand. Quoted in Besana-Galluzzi, "Geometria e latino", p.1291.
[87] Ibidem, p.1292.
[88] Idem.
[89] See, for instance, Amodeo, *Vita matematica napoletana*, vol.2, p.188.
[90] Gino Loria, *Nicola Fergola e la scuola che lo ebbe a duce* (Genoa: 1892) p.21.
[91] Ibidem, p.131.
[92] Vito Volterra, "Le matematiche in Italia nella seconda metà del secolo XIX", in Vito Volterra, *Saggi scientifici* (Bologna: Zanichelli, 1990, orig.ed. 1908) p.61.
[93] Massimo Galluzzi, "Geometria algebrica e logica tra Otto e Novecento", in *Storia d'Italia. Annali 3*, p.1016.

[94] Giovanni Ferraro and Franco Palladino, *Il calcolo sublime di Eulero e Lagrange, esposto col metodo sintetico, nel progetto di Nicola Fergola* (Naples: La Città del Sole, 1995).
[95] "The two groups were using synthesis and analysis merely as two flags to cover a political battle", Franco Palladino, personal communication, July 1997.

Chapter 2

Knowledge and Society in the Critique of the Neapolitan Enlightenment

As we have seen in the previous chapter, Fergola's project to restore the "dignity" of geometrical methods loses some of its eccentricity when placed in the context of a wider foundationalist program. Still, it is the specific nature of this restoration, and its very reasons, that should attract the attention of historians, and push them to go beyond the mere recognition of the "backwardness" of Fergola's ideas. In order to set the stage for my further analysis I shall present, in the next part of this study, some aspects of that "analytic way of thinking" which became so popular in France and in the Italian states during the second half of the eighteenth century. This will provide the background against which the emergence of Fergola's school can be best understood. A main tenet of this study is indeed the reactive nature of Fergola's approach to geometry, and to mathematics in general. Only by clarifying the more general meaning of embracing an analytic approach to mathematics (and to knowledge in general), it will be possible to make sense of Fergola's reaction. If in the first chapter we made sense of the controversy by linking the opposing methods to two different conceptions of mathematics, now we shall link the analytic approach to a specific representation of the structure of knowledge. Yet the study of a structure of knowledge requires intellectual history to be integrated with other relevant resources. In the present case these are chiefly social and economic history. The system of ideas of those criticising the *ancien régime* did not spring out of pure speculation, as we will see[1]. The protagonists of the next pages were not just speculating. They were thinking and acting for "the sake of the country", and for that of their own fortunes.

2.1 Early Reformism and the School of Genovesi

The emergence of the controversy over geometrical problem-solving method as a relevant scientific issue traces back to the 1780s. Its emergence coincided with what has been defined as "the high summer" of Neapolitan Enlightenment, i.e. a period when important reforms of the economic, juridical, administrative and cultural institutions of the kingdom were discussed and implemented. The independence of the Kingdom of Naples (1734) and the arrival of King Charles Bourbon had ushered in a period of structural changes, a new economic policy and a new foreign policy being indeed urgently required. The *ancien régime* structure of the Southern state was inadequate to support the ambitious plans of the newly established monarchy, and this contingency provided the opportunity for a group of intellectuals actively to co-operate with the Crown to design a new, more "enlightened" society. Themes in focus were: the overly complex legislation; the inefficient administrative system, particularly the revenue system; the economic policy; and the system of public education. A particular feature of the authors of the Neapolitan Enlightenment was their prevalent interest in social and economic matters, the themes of scientific and technological innovation remaining somehow subordinate. These "reformers" had first of all to contest the cultural and economic power of the Roman Church over Neapolitan society. In its defence of the rights of the state and of the Crown against the claims of the Church, Neapolitan reformism could indeed rely upon the rich local tradition of "jurisdictionalism" (*giurisdizionalismo*), which had been fighting the interference of the Roman curia in the public life of the kingdom during the previous decades. A hated symbol of the Roman claims was the annual tribute of the *chinea*, a white horse which was offered yearly by the Neapolitan King to the Pope, in recognition of his formal condition of vassalage. Given the crucial value of the issues at stake in the dispute between curia and state (taxation of ecclesiastical possessions, investiture of bishops, limits of the ecclesiastical jurisdiction, book censorship, education), it is hardly surprising that a wide juridical apparatus had been refined by lawyers close to the Crown in order to fight back the Roman pretensions. In the end, the anti-curial battle had always found strong support in every section of the Neapolitan society, being hardly a reason of social divide. What was new in the reformist approach to the problem was its being inserted in a much wider cultural and social project. The anachronistic and historically unfounded claims of the curia were seen as just one of the many irrational aspects of Southern society. The battle for a state freed from the control of the Church had to be integrated with a serious anti-feudal program, in order to permit a redistribution of wealth among a peasantry impoverished by a long-lasting agricultural crisis; by economic programs to increment and to regulate the growth of trade and manufacture; and by legislative programs to re-design the entire legislation. It is in the context of this early reformism that we can make sense of certain specific cultural phenomena of the 1740s, such as the growing opposition to traditional streams of thought which had been dominant at the turn of the century —namely Cartesianism and Platonism— to the advantage of a revised version of Newton's natural philosophy. The renewal of the scientific and philosophical culture found concrete institutional realisation in the impulse given to the teaching of natural sciences and mechanics. This included the foundation of a new scientific academy, born under the protection of the government with the explicit goal of supporting Newtonian philosophy. Key-figures in this early reformist phase were Bartolomeo Intieri (1678-1757), defender of the new analytic methods in geometry[2], Celestino Galiani (1681-1753), responsible for a reform of the university which improved the teaching of scientific disciplines (1735), and for the foundation of the Royal Academy of Sciences (1732), and Antonio Genovesi (1712-1769), professor of political economy and, in fact, the most influential philosopher and economist in eighteenth century Naples. In Genovesi's writings themes of local interest, such as the need of specific reforms in agriculture and administration, were treated from a new perspective inspired to British and French authors. Without openly rejecting the Neapolitan tradition in theological and juridical studies, which had framed the production of knowledge in the previous decades, Genovesi gave unprecedented space to themes from the empiricist tradition linked to the work of John Locke, such as the philosophy of nature and the methodology of science and logic. Resistance to the new empiricist culture —and to the program of social reforms that this culture supported— was strong, as it is clear from Genovesi's failure to obtain the chair of

Theology at the RUN during the 1740s. In 1754 Bartolomeo Intieri established at his own expenses a new chair of political economy (*Commercio e Meccanica*, literally "Trade and Mechanics"). It was the first chair of its kind ever created in Europe, and it was offered to Genovesi. In his inaugural speech, significantly titled *Discourse on the Real Goal of the Letters and the Sciences*, Genovesi stated clearly his cultural and social program, which was based on the assumption that every intellectual activity must be directed towards the improvement of the material conditions of life of mankind[3]. Human reason, the greatest and most noble divine gift, is described as the "universal art", which through the "instrument" of the "human machine" originates the "life improving arts"[4]. Following the nature of reason, one has "a geometry which is not idle, but perfects the mechanical arts" and "a physics which promotes our welfare, without being magic"[5]. So that "one cannot say that reason has achieved its maturity in a country where it is still placed in the abstract intellect, rather than in the heart and in the hands"[6]. The attack on the idle metaphysical speculations and the need for philosophers to co-operate with artisans in order to promote industry and trade continued in Genovesi's *Academic Letters on the Question Whether the Ignorant are Happier than the Scientist* (1764), where the myth of the good savage is ironically discussed (and rejected). About the sciences, Genovesi wrote:

> I would say to mathematicians: more instruments and more practice, more mechanics, get familiar with the arts, be useful to mankind. I would say to physicists: fewer subtleties, fewer useless questions, more about mechanical motion, more experience. Help mankind: the sciences have to work for its benefit.[7]

Around this chair the so-called "school of Genovesi" coagulated between the 1750s and 1760s. Its members were to be at the core of Neapolitan Enlightenment. The institution of the new chair marked symbolically the turn of Genovesi's interest from metaphysics to political economy and to the rational administration of the state. It was "a definite move away from the world of tradition, the clergy and the academics"[8]. Genovesi's teaching was characterised by his Lockean perspective, integrated with elements from French sensationalism, particularly Condillac's. Materialistic interpretations of reality were offered later by some of his pupils, but they were extraneous to the orthodox religiosity of Genovesi. Between 1754 and 1769, the year of his death, Genovesi trained a new generation of young reformers in the exercise of designing a governmental economic policy suitable to face the critical situation of the Southern state. Public incentives to manufactures; free-trade —particularly for cereals; the creation of agrarian societies; the improvements of specific cultures such as silk and olive oil, are among the themes which can be found in his writings. The need for a more effective policy in this sense became tragically evident in the occasion of the 1764 famine, which ravaged the whole kingdom causing thousands of deaths. It was the last great famine to hit an Italian state, and its effect on reformers was deep. An inefficient state and an old-fashioned system of grain deposit were among the causes of the disaster, which in turn highlighted the striking gap existing between the conditions of life of the privileged groups and those of the growing masses of agricultural day-labourers. To Genovesi, one primary issue arising from the 1764 famine was that of public education. His favourite themes, such as the teaching of modern agricultural techniques, the creation of public schools, the use of the Italian language in printed books, the publication of manuals of agriculture, economy, law, and the reform of the university, all acquire their most proper meaning when seen on the background of the 1764 famine. But in the last years of Genovesi's life the structural limits of the co-operation between reformers and Crown also emerged. Too many compromises and too much gradualism had indeed characterised the policy of Prime Minister Bernardo Tanucci (in charge from 1759 to 1776). The socio-economic conditions of the kingdom required, according to the reformers, a more resolute action. The late sixties and early seventies marked a moment of crisis for Neapolitan reformism. Genovesi himself, in his last writings, attacked with unprecedented violence the clergy, the provincial landlords, and the lawyer class of the capital: three "orders" which he accused of actively opposing any serious process of reform in the kingdom, because it would harm their corporate interests. Genovesi pointed out how their interests were inextricably connected to the preservation of the present state of abuse. Such themes are central in the most representative text of the early reformist tradition, Genovesi's *Lessons on Trade* (1765-67)[9]. They are the best example of the new civil philosophy, which is "practical and useful to mankind". The public addressed by this book is, in Genovesis's own words, the "ceto mezzano" (middle order). The overcoming of a society founded on exemption and privilege, and the equality of everyone in front of the law are stated as fundamental goals of every "civilised state":

> Let the land of the state be measured palm by palm. Let it be evaluated. Let all of it be subject to taxation: not an inch be exempted. There is neither to be ecclesiastical nor baronial exemption, when it comes to the royal taxation. Let all the citizens enjoy the fruits of civil society and of the government. Thus, everyone's possession must be subject to taxation proportionately to their value. Let inequality be abolished, because it was born in times of ignorance and partiality. Let civil freedom be given back to the families. Let be the spirit of peasants, of shepherds, of artisans freed from those ties which humiliate it and make it lazy.[10]

This is the "fundamental law of the every people", Genovesi remarks "fertilizer of industry and the arts"; but he concludes by remarking "how many enemies" such a program has in Neapolitan society. About the role of the sciences, we have already seen that Genovesi considered the sciences and the arts as real forces behind the civil development of the countries, and on this basis he included in his plan the creation of scientific academies, agrarian societies, libraries, and professional schools. The mathematical and physical sciences were not taken as sources of eternal truths (or, at least, this wasn't their more important aspect), but as the instruments for the social and economic progress of the country. Throughout the entire *Discourse* an instrumental conception of science was presented, with social problems having absolute pre-eminence over theoretical ones. The main polemical target was the idea that a "pure science", deprived of practical utility, is intrinsically superior to the applied sciences (or "mixed mathematics").

In the 1770s the voices of the so-called "second generation" of reformers began to be heard. Its members included first-rank politicians, such as Domenico Caracciolo (1725-1789), and well-known students of law and society such as Giuseppe Galanti (1743-1806), Gaetano Filangieri (1752-1788), Mario Pagano (1748-1799), and Melchiorre Delfico (1744-1834)[11]. All of them had studied with Genovesi. It is by considering the activity and the theoretical framework of these reformers that we shall reach the period of our present concern, the 1780s and 1790s. While keeping Genovesi's empiricism and sensationalism as a background for their investigations, late reformers did not delve into the philosophical problem of the origin of knowledge, which had intrigued their maestro. Rather, they followed his indication about turning attention to the real problems of the country. Their common aim was indeed that of "demystifying" their own disciplines (economy, law, history), that is to say, to detach technical considerations from their traditional metaphysical presuppositions. The existence of an ultra-mundane sphere of religious values was rarely denied by these authors, who mostly thought of themselves as orthodox Catholics. Still, they believed their spiritual inclinations should not interfere with their planning of a modern, "civilised" society. Such a secularised conception of the moral and natural sciences was indeed considered as the first step to reducing the practice of politics, legislation and economics to a matter of rational administration.

By the mid-seventies the only area where the reformist front had partially succeeded was the battle against the abuses of the Roman curia. The most significant episode of this campaign was the expulsion of the Society of Jesus from the kingdom, in 1767. But the results of the process of reform of the structure of the state and of its economic policy were considered deeply unsatisfactory. The very structure of the Neapolitan society, with its striking inequalities, had been left untouched. In fact, the Southern kingdom was still a feudal-communal society. Deprived of much of their political power, the barons kept almost unaltered their juridical and economic privileges, particularly in the provinces and in the Sicilian viceroyalty. Here the authority of the central government was filtered by a number of intermediate bodies, which reduced the exercise of power to a complex activity of mediation between contrasting local interests, which were embedded in institutions such as baronial jurisdictions, feudal autonomies, and common lands. This *status quo* came under attack when members of Genovesi's school moved from their master's battle against feudal and ecclesiastical abuses to question the very existence of feudal system *tout court*. The feudal-communal system of land came indeed to be considered the main reason for the lack of economic and civil development of the country. The abolition of feudalism in all its forms, which had never been openly discussed by Genovesi, became the *conditio sine qua non* in most of the new reform plans since the late 1770s.

The fall of the moderate Minister Tanucci in 1776 seemed to open a new space of action for the second generation reformers, whose theorising was becoming more radical in its analysis of the nature of power. The Bourbon monarchy supported this anti-feudal trend, particularly the Queen, the Austrian Maria Carolina, sister of Joseph II Habsburg and of the French Queen Marie Antoniette. Genovesi's pupils entered in number the government ranks, and more resolute actions were taken. The most significant were the university reform (1777), the foundation of a new

Royal Academy of Sciences (1778), the creation of the *Cassa sacra*, an institute of credit designed to support the creation of a new class of small landowners (1784), and the reform of the army (1785-88), which reduced drastically the right to command of the aristocracy[12]. In 1781 Domenico Caracciolo became Viceroy of Sicily: he began a campaign against the privileges of the local barons and abolished the local Tribunal of the Holy Inquisition. He was soon to be prime minister (1786-1789). Still, the intrinsic limits of the absolutist strategy of the Bourbon were evident. Radical issues were emerging from the philosophical reflection about the foundations of property and power, and about the controversial notions of "equality" and "freedom". Moreover, the resistance to socio-political reforms was growing strong, as they —unlike the anti-curial reforms— were touching at the heart a well rooted system of economic and political privileges.

2.2 The Critique of the Feudal-Communal System of Land

Let us consider now, more concretely, some of the typical issues of late reformism[13]. A first important claim was that the kingdom was unknown to its inhabitants. This meant that basic infrastructures such as roads and canals had to be rationalised on the basis of a better knowledge of the nature of the country and that, in general, the economic potential of the natural resources existing in the provinces was still to be studied and exploited. Indeed an important contribution to the reformist movement came from the provinces, mainly by landowners who had an interest in rationalising the productive processes under their control, in developing new agricultural techniques, or in commercialising certain products (the so-called *industrianti*). It is the case of the reformer Domenico Grimaldi (1735-1789), from the province of Calabria, who introduced in his lands the irrigation techniques from the Lombard plan, and hydraulic reeling machines for silk from the manufactures of Piedmont. He had personally studied such innovations during his travels in Northern Italy. Grimaldi was particularly known for another technical innovation, on which he wrote in 1781[14]. One of the major producers of olive oil from Calabria, Grimaldi was looking for the support of the government to improve the quality of his product. In fact Calabrian olive oil was notoriously inferior in quality to Genoese oil, its direct competitor on European markets. Difference in price was of about one-fourth. In his more general reflections upon the economic situation of the kingdom, published as *Reform Plan of Public Economy* in 1780, Grimaldi stated that "ignorance" was the main obstacle to progress in agricultural production[15]. He meant the ignorance of both peasantry and government as to which are the more "effective" methods of production. The remedy was, quite typically, the institution of agricultural schools to diffuse the practice of the new techniques, and of economic societies, in order to provide credit to landowners to renew their instrument of production[16]. We are here at the core of Neapolitan reformism, which greatly relied on the intervention of the government to demolish the ancient institutions, given that the socio-economic conditions of the kingdom were considered too backward for the immediate introduction of a policy of *laisser-faire*. But the experience of Grimaldi proved that similar initiatives were to face unexpectedly strong resistance.

The Neapolitan economy was essentially agrarian, based upon two main sectors. One was the subsistence sector, which was predominant; the other was the commercial sector, which was located in some coastal area where specialised cultures such as olives and mulberries (for silk) were concentrated. Given the lack of internal industrial and commercial growth, these specialised products could only rely on the demand of foreign markets. It is clear why, in this very limited context, the attention of reformers focused on the improvement of the transformation processes. The main problem was to move productive techniques from the subsistence framework to a modern commercial framework, to make the best out of the growing foreign demand (exportation was actually *growing*, in spite of the pessimistic statements of reformers). This was the aim of men like Grimaldi.

The most formidable obstacle to such a program was the land system[17]. A feudal-communal regime was operating all over the kingdom, its salient feature being this: no one class possessed the full propriety over land. The kingdom was divided into small autonomous administrative units, called *università*, which included common lands, private lands and ecclesiastical lands. But every piece of land was in fact subject to a number of different "rights" owned by different legal agents. So, for instance, peasants enjoyed certain rights on private lands (grazing was one), whereas the feudatory possessed monopoly powers over the production or transformation of specific products (like milling olives). Such a system granted the peasantry a relatively secure entrenching upon land, by means of the traditional share-cropping tenures. This land system made the switch from subsistence crops to commercial crops very difficult. The *università* were scarcely responsive to the pressure towards the commercialisation of its products and towards specialisation. The land system operated constantly as a factor of resistance to any change of the subsistence economy on which it had grown up. This considered, the lack of credit available for landlords was possibly less relevant a factor than it could seem. It was the land system itself that denied landowners the opportunity for investments. The maintenance of the subsistence economy was also defended by a fiscal system which openly discriminated against the commercial sector. Indeed, the fiscal system had been designed during the seventeenth century by the Spanish rule in order to obtain short-term revenue; heavy taxation was consequently put over prosperous branches of the economy such as production and exportation of olive oil and silk.

A general consequence of this stagnant economy, where investments were discouraged by the land and the fiscal systems, was a high propensity to consume. Consumption took place almost exclusively in the capital, where most of the landowners owned residencies. Merchants of the town owned special rights to import products from abroad at reduced duties. More than one tenth of the whole population of the kingdom lived in the overcrowded capital (around 600,000 inhabitants), whose economic existence depended ultimately upon the continuous influx of funds from the provinces, be they public revenues or baronial incomes.

These highly schematic remarks should be enough to point out that the low level of investment and the slow rate of development of provincial agriculture on one side, and the overgrowth of the capital on the other side, were in fact closely interconnected phenomena. This precarious economic equilibrium would be seriously endangered by any attempt aimed at changing the landowners' absenteeism or diverting their profits towards agricultural investment. The dismantling of the feudal-communal system would produce —at least as an immediate result— a dramatic increase of the level of unemployment in the capital.

Other economic and financial activities grew up within the feudal-communal system, with the effect of reinforcing its stability. Since the late eighteenth century the credit system which allowed most of the agricultural producers (landowners or tenants) to survive was in the hands of a restricted group of financiers and merchants of the capital. Large revenues at low level of risk were guaranteed by the institutionalised methods of advancing credit, such as the *contratto alla voce* ("verbal contract"), by which merchants bought crops one year in advance at very low prices, exploiting precisely th chronic lack of agricultural investments which was related to the ongoing crisis of agrarian economy.

The forces opposing attempts to overthrown the feudal-communal system and to improve the production and transformation of oil and silk appear now to their full extent. It is not surprising that most of the reformist efforts, including Grimaldi's, ended in failure. Consider the improvement to the production of oil introduced by Grimaldi in his own lands, as it is described in his 1781 essay. It consisted in the introduction of the Genoese olive press to replace the traditional one (*trappeto*). Grimaldi began to experiment in 1769, and the results were reported to the king himself. The first experiments were successful, and in 1771 Grimaldi hired specialised Genoese personnel and transformed his entire crop according to the new method. The results were crystal clear to Grimaldi: the Genoese press required less labour, it produced more oil, it produced better oil (i.e., more clear and palatable). On the basis of these results, Grimaldi forecast a rapid diffusion of the machine all over the kingdom. In fact, the method began to be adopted by some of Grimaldi's neighbouring landowners. The new press was smaller and cheaper than the old one, so that a producer could install more presses over his land overcoming the traditional problem of periodical overproduction. Because they were expensive and complex, the old presses were indeed too few to deal with particularly rich crops in due time. Grimaldi calculated that 400,000 ducats were wasted every year because of the inefficiency of the old system, based on a few scattered pressing plants[18].

By 1783, when Grimaldi re-organised oil production after the Calabrian earthquake, he could state that "in that province [i.e. Calabria] there are already many Genoese presses introduced by myself"[19]. The Calabrian earthquake was to Grimaldi an occasion not to be wasted. Most of the traditional fixed plants for the production of oil had been damaged: they could now be replaced with Genoese ones. But this required a special availability of credit for the impoverished Calabrian landowners, who had been suffering a block of the trade following the American war (1777). Grimaldi asked for a state loan. He denounced the "illegal" profits made by Neapolitan financiers with the *contratto alla voce*. Grimaldi's suggestions were only partially met by the government. In the end the "occasion" provided by the earth-quake was lost, the state-lead "modernisation" of oil production did not begin, and the whole experience remained an isolated case.

Behind Grimaldi's substantial failure was not simply "ignorance" of the new techniques or the lack of funds. It is quite clear that the introduction of new techniques of agricultural production and transformation would have a deep impact on the existing feudal-communal system. In the case of the Genoese press one can remark that, for a start, the diffusion of the new cheap presses would certainly jeopardise the feudal monopoly over oil milling. To those of the feudatory who possessed mills but did not produce oil, Grimaldi's arguments in favour of the new press would hardly sound convincing. But, let us consider the producers themselves. The remarkable reduction in the number of required hours of labour would cause further unemployment in an already overpopulated countryside, accelerating the process of social desegregation which was threatening the traditional structure of the rural world; this was hardly a pleasant perspective if this single technological innovation was not part of a wider network of technical innovations and socio-political reforms, as it was indeed for Grimaldi. Furthermore, the production of a better quality of olive oil would necessarily require a re-orientation of the overall strategy of their commercialisation. Those markets interested in Calabrian oil for industrial usage, such as the soap manufactures of Marseille, would be lost if its price rose; and new investments would be required to open new markets, entering into competition with the Genoese oil. Grimaldi was well aware of these strategic implications of his innovation, as is clearly shown by his attempt to constitute a society of Calabrian oil producers, around 1785[20]. But such commercial developments were at odds with the interests of the merchants and financiers of the capital, who enjoyed *de facto* a monopoly on both olive oil exportation and the sale of credit to provincial landowners, both of them based on the lack of similar organisations of producers. These remarks can help to make sense of the failure of Grimaldi, and of the "ignorance" on the governmental and entrepreneurial side. Similarly, the argument of the "ignorance" of agricultural labourers advanced by Grimaldi should not be uncritically accepted. Historical information on this issue is scarce; but Grimaldi himself tell us of attacks by locals against the families of Geonese workmen, and of the attachment of local (unskilled) labourers to the rudimentary Calabrian press. Such hints suggest a more articulated explanation for Grimaldi's failure. I hope they also suggest that the feudal-communal system of land management can indeed be thought of as a complex network of technical devices, social and juridical institutions, and cultural resources[21]. The radical change of a single element of the network is then impossible if other elements and the relations among them must be conserved unaltered. Certain specific technical innovations or certain specific social reforms which would harm the stability of the system can be seen as "structurally" impossible. This was the case of Grimaldi's press.

Another important voice of the provincial reformism was that of Giuseppe Palmieri (1721-1794), from the province of Apulia. An analysis of his campaigning for export tariff reform will bring us to the core of the Neapolitan taxation system, another *bete noir* of the Neapolitan Enlightenment. Unlike Grimaldi, Palmieri was a civil servant, being a member and later the president of the Supreme Council of Finances. Still, his campaigning was to encounter the same formidable opposition as did Grimaldi's. Palmieri considered primarily the exports of olive oil, the most important single Neapolitan export[22]. He remarked that the duties on oil export were excessive and they were seriously damaging its potential expansion, which was a commonplace among reformers. Furthermore, heavy duties on exports were not damaging the merchants of the capital or the great landowners, as they had the power to discharge additional costs upon small tenants and day-labourers caught up in the feudal-communal system. The central issue here was the system of the *arrendamenti*, by which the government charges private companies to raise taxes over specific products. (Notorious for their voracity were the *arrendamento della seta* and the *arrendamento dell'olio e sapone*). Palmieri pointed out that in the case of olive oil the damaging effects of duties were most evident. Duties had been accumulating over the years, regarding every single stage of the process of collection, transformation, and transport of the product. The overall complexity of the revenue system was a clear expression of the inability of the central government to control its local branches and to contrast local interests. But a serious tariff reform would require, first of all, a reform of the system of weights and measures, without which it would be impossible to raise a single uniform duty on the export of oil. The effects of the lack of a uniform system of weights and measures upon Neapolitan society were many and profound. It was considered as the main obstacle to commercial progress in general[23]. The problem was to re-emerge again in the early nineteenth century, as we shall see. Palmieri's proposal to address the tariff question contained two main points: the government should recover control over public revenues and it should introduce a new single system of weights and measures. But the resistance of groups whose interests were to be affected by the reform, in this particular case the shareholders and the administrators of the *arrendamento dell'olio e sapone*, was too hard to overcome. Palmieri acutely noticed that the strongest opposition to his proposals originated from members of the lower provincial administration of the *arrendamento*, whose livelihood was directly threatened[24]. Their opposition was so obdurate that they attacked every part of the proposed reform, even those less directly relevant, such as the reform of the system of weights and measures, whose complexity was presented as an heritage of "ancient wisdom". Interestingly, not even the powerful lobby of the oil merchants of the port of Gallipoli, in Apulia, supported the reform of weights and measures. An abstract sociohistorical description where the "middle classes" or the "merchants" supported the plans of reform against the resistance of the landed aristocracy would be unable to capture the complex reality of late eighteenth century Naples. Merchants themselves had built their fortunes upon the feudal system we have been describing. In this case, one reason for their opposing the reform was that they had been exploiting to their advantage the lack of an homogeneous unit of measure for olive oil, and increasing their profit at the expenses of local producers. In 1790 it finally became clear that the battle for tariff reform, which included the reform of weights and measures, had been lost. The plan presented by Palmieri had been introduced with substantial amendments and the few surviving innovations were not practically actuated. Reformers began to believe that the main obstacle to any real change in the economic and social system of the kingdom was the Crown itself, too sensible to the pressures of the financial oligarchy of the capital. In fact the Bourbon were themselves heavily mortgaged by those very same elements which had built their fortune upon the feudal-communal system.

The manufacture of silk also reveals the relations between mode of production and feudal-communal system. The duties on silk were many and were extremely high. Almost every Neapolitan reformer asked for their lowering and for state loans to modernise the techniques of reeling, to face the growing foreign competition, particularly by Northern Italian producers. Here an hydraulic reeling machine, called Piedmontese after the state of Piedmont, was employed which permitted the production of high quality raw silk (*organzino*). Grimaldi, Galanti, Palmieri, and others pointed out that hydraulic reeling machines —which had been praised by Diderot himself in the first edition of the *Encyclopédie*— should be immediately adopted in the provinces of the kingdom. They also denounced the *arrendamento della seta* for its constant opposition to any change[25]. In fact the *arrendamento*, which controlled the whole production and transformation of silk, had been designed, as the other *arrendamenti*, to collect taxes. The "logic" of this institution was not at all a logic of the market; indeed for its members it was perfectly rational to fight technical innovations, and to preserve the "inefficient" traditional methods. Indeed, duty was imposed upon every pound of raw silk produced. From a given quantity of cocoons, the traditional method produced a greater weight of raw silk than the new Piedmontese one. Introducing the new method would improve the quality of raw silk, but it would also imply a loss of revenue for the *arrendamento*. The position of the administrators and shareholders of the *arrendamento* was backed by the reelers (*maestri trattori*) themselves, who were paid for each pound of silk reeled. A number of other issues reinforced the resistance to such technological innovation. So, for instance, hydraulic machines had to be placed outside of the inhabited centres (where traditional plants were), and this would increase smuggling, with further losses for the *arrendamento*. Or, again, women workers were preferred for the hydraulic machine, whereas traditional reeling was an activity reserved to men. The only possibility of change would come from the direct intervention of the government, in the form of the abolition of the monopoly of the *arrendamento* and the introduction of private initiative in the production process, which was precisely what reformers were asking for, in the name of the principles of economic liberalism. Again, as in the case of the press, one single technical innovation was rational and desirable only to those who were willing to change the whole network (the feudal-communal system). The evident "rationality" of the technical innovation faded before the eyes of those whose interests were served best by the existing network. That the Genoese press or the Piedmontese reeling technique were "better" than their traditional counterpart could only be consistently claimed by those who agreed with the reformers on the need for a free-trade economy, for the *industrianti* landowners to become competing entrepreneurs, and on other goals which can be more or less directly related to economic liberalism. These considerations should help us not to lose sight of the fact that the theoretical productions of the Neapolitan Enlightenment were elaborated by men who were themselves deeply involved in very practical questions. Landowners, civil servants, professors, and even clergymen, were attacking the feudal-communal system in its very concrete manifestations, whether they were "excessive" duties, "confusing" systems of measures, or "ignorant" resistance to technological innovation. This is why I believe that their referring to English and French economists, or their defending —contemporaneously— neo-mercantilist and liberal ideas, should not be seen as essential issues in a historical reassessment of this movement. Reformers used those ideas that seemed more suitable to fight their own battles, case by case, everyone according to his personal experience.

That the enemies of their plans of "modernisation" of the country were many and powerful ones emerged clearly around 1790, when the wave of reformism ended up in a generalised failure. The 1790s began with the diffused feeling that the monarchy was no longer a reliable ally. By the 1780s every provincial centre had his own place where noblemen, bourgeois landowners, clergymen, physicians, and scholars regularly met to discuss issues such as those I have been describing. Usually these meetings were hosted in the mansion of some "enlightened" landowner. There was a lack of specific institutions devoted to such a function. The lodges of Neapolitan freemasonry offered precisely the form of organisation that was needed[26]. Most of the reformers took advantage of the new form of "sociability" offered by the pre-existing Masonic lodges. Grimaldi, for instance, was a member of the lodge of Reggio, in Calabria. Another important provincial reformer, Melchiorre Delfico, from the Abruzzi, hosted the local lodge in his own mansion of Teramo. The provincial reformism was generally technical, problem-specific, based on accurate descriptions, and supported by men who were themselves part of those productive processes that they wanted to change, or by civil servants aware of the need for structural modifications in the current rules on trade, or in the tariff system. Reformers from the town of Naples conducted generally a more theoretical kind of work. Men like Francesco Antonio Grimaldi (brother of Domenico), Gaetano Filangieri, Mario Pagano, Francesco Longano were scholars and professors whose essays dealt primarily with problems such as the science of legislation, the principles of criminal law, or the role of the monarchy in a modern state. As in the provinces, even in Naples the party met in private mansions. After Genovesi's death (1769) the RUN had ceased to be the main point of aggregation for the reformers of the town. Mario Pagano held a chair (Criminal Law), but his position in the academic world was not as relevant as Genovesis's. The villa of the Dukes di Gennaro, just outside Naples on the road to Posillipo, became the place where reformers regularly met. Among them were Melchiorre Delfico, Antonio Pianelli and the famous physician and botanist Domenico Cirillo. The works published in the 1780s by members of this group were the most significant theoretical production of Neapolitan reformism: Grimaldi's *Reflections on the inequality among men* (1779); Filangieri's *The Science of legislation* (since 1780); Pagano's *Political Essays* (1783); and Pagano's *Considerations on Criminal Trials* (1787)[27]. Between 1783 and 1784 the group also had its own periodical, the *Miscellaneous Selection*, where pieces by Genovesi and Vico were reprinted, together with comments on the Constitution of the United States of America, and reviews of the books by Grimaldi, Filangieri and Pagano. As in the provinces, even in Naples the group reinforced its theoretical and social cohesion through the Masonic connection, particularly from 1786, when a lodge of the politically subversive *Illuminati* was founded in Naples[28]. These reformers were fighting the same battle as the provincial reformers, though in different fields. Filangieri, for instance, denounced the conservative attitude of the legal world towards any transformation of the legal system in the direction of a modern enlightened despotism. Pagano did the same with the juridical system. They aimed to overcome that same feudal-communal structure which was attacked by economists; and they had to face the same formidable resistance.

A remarkable character of these works is the elaboration of a complex philosophy of history, as a framework where reformism could be theoretically articulated and justified. Vico's cyclical theory of history enjoyed great success, as it was re-interpreted to fit with the reformists' anti-feudal polemic. Following the success of Filangieri's work, the historical origins of feudalism were investigated, as well as the current political function of aristocracy. The fact that the legitimisation of baronial jurisdiction was a matter of discussion was in itself a crucial novelty. In the late 1780s, the pessimistic tones of Pagano's cyclical vision of history seemed to prevail. That a modern, civilised society could be established by means of a gradual and painless transition was hard to believe, given the failures of the reformist front. The overcoming of the feudal system began to be compared with some sort of great natural catastrophe. It is indeed remarkable the way in which Pagano made use in his work of the great Calabrian earthquake of 1783[29]. In the preface of his *Essays*, the natural disaster is not only employed metaphorically, but it is also presented as revealing that the very basis of civil society could be easily dissolved by natural events; and in this case there would be a return to an original form of equality and liberty. Pagano's work is permeated by the feeling that the inertia of the government in turning the reform program into reality will have disruptive effects on society. Not surprisingly, the *Considerations'* motto is from Tacitus: *Sed, dum veritati consulitur, libertas corrumpebatur*. Knowledge about the social and economic conditions of the kingdom, and about the necessary reforms, was now available to the ruling class: two generations of reformers had worked for that; any further delay of action would be deadly for the country. The example of the late seventeenth century modern movement was there to warn reformers. Francesco Saverio Salfi (1759-1832) wrote in 1787 that "a little practical application [of reformist principles] is what the interest of the people now cries out for"[30]. During the 1780s most reformers had personally entered public administration. It was the moment of maximum reformist effort. Pagano entered the Admiralty Tribunal; Filangieri and Palmieri the Council of Finances; Domenico Grimaldi and Galanti became Visitors of the Realm. But we have already seen the kind of quick-sands they were getting into. In spite of the action of sympathetic ministers such as Luigi de' Medici and John Acton (1736-1811)[31], resistance to change could not be overcome, particularly at the local level (recall the practical impossibility of changing the tariff system, even when its reform had the approval of the central government). By 1794 the reform movement as such did not exist any more. The court and the government had deprived it of their support, while both internal and foreign policy were suddenly changing following the revolutionary events of France. Among the last voices of Neapolitan reformism to be heard was Nicola Fiorentino (1765-1799), who proposed the last plan of general reform in his *Reflections on the Kingdom of Naples* (1794)[32]; and Galanti's *New description of the Two Sicilies* (1786 to 1794, when he was forced to stop publication). Galanti is dominated by historical pessimism. His criticisms of the provincial gentry were as violent as they were despairing:

> Our laws, for most part belonging to feudal government, have scorned the condition of the farmer and have favoured the classes of idle men [...] All those among us who have talent and a little money devote themselves to the lawcourts, or to medicine, or to become a notary or a priest and in this way scrape a living among the people [...] From here stems the wretched and wasteful kind of existence in which the inhabitants of small provincial towns aimlessly idle away their time.[33]

By 1794, when reformers were outplayed by the government, those who believed in the necessity of change had found new forms of organisation, and were preparing much more radical plans of action. The "catastrophistic" vision of Pagano, together with the "facts of France" were taken as suggesting a different approach to the question of demolishing the feudal system. From our point of view the failure of the pressure of the reformers in achieving any relevant result seems almost an obvious outcome. In the 1780s they were little more than an elite group of authors who represented the interests of urban tradesmen and entrepreneurs, as well as "enlightened" landowners in the provinces. Such interests would be better matched by some form of controlled liberalism and free-market. But these interests proved to be extremely weak when it came to direct confrontation with the interests embedded in the feudal-communal system. Large sectors of the public administration, particularly its local branches; shareholders and administrators of private companies holding monopolies over the production and taxation of specific products; the big merchants of the capital who monopolised the exports and were able, thanks to the legal system, to discharge the risks of a fluctuating market upon the agricultural labourers; lobbies of local tradesmen and merchants who exploited the confusion of the measures system; bankers of the capital who sold credit to impoverished tenants at 20% rate of interest. From the few examples shown above it should already appear that the economic system that grew up within the feudal system in the eighteenth century had an inertia that a gradual policy of reforms could not easily sweep aside. Another source of resistance should not be underestimated: the peasantry. The general condition of life of the peasants had been declining during the whole century, as landowners (feudal and bourgeois) and central government were gradually eroding the system of common lands on which they could rely. The result was a deterioration of the traditional forms of social life in the countryside. The plans of the reformers were seen as threatening yet further the already precarious conditions of agricultural labourers (witness the opposition to new presses for olive oil). These feelings were particularly strong among the peasants of the poorest provinces, such as Calabria, and they were to find their most concrete expression in the counter-revolutionary phenomenon of the Army of the Holy Faith, in 1799.

2.3 Reformism, Mathematics and the Structure of Knowledge

In the previous pages we have been drawing a picture of the Neapolitan situation, according to which, in the 1780s a rather aggressive movement for the reform of the feudal state seemed to have encountered the favour of the Bourbon monarchy, even if concrete results were obtained only in very limited sectors (mainly the anti-curial campaign), without touching the economic and social structure of the kingdom. It should be noted that, at the same time, teaching and research in the mathematical sciences was languishing in Naples (on the historical and cultural reasons for the decline of mathematics in the early eighteenth century see **Appendix 4**). Vito Caravelli (1724-1800), a former pupil of Nicola di Martino, was the only noteworthy mathematician active in the 1770s and early 1780s. Indeed, he wrote the first textbook of calculus ever published in Naples[34] (1786), for his pupils at the Royal Academy of the Navy. He also prepared textbooks in arithmetic, algebra, geometry, trigonometry, mechanics, hydrostatics, hydraulics and nautical science. Since 1770 Caravelli was Director of the Military Academy (*Regia Accademia Militare*), which had been created the year before by the reunion of the former Academy of Artillery and the former Academy of Military Engineering (*Regia Accademia del Corpo degli Ingegneri*, founded in 1754). The "de-professionalisation" of the mathematical sciences at the RUN to the advantage of the military schools and academies had been continuing even in the period of the greatest reformist effort. University professors had to supplement their low wages with private tuition, and the conditions of scientific careers had remained remarkably precarious. The fact that Caravelli never entered the RUN, while a chair was held by the obscure Giuseppe Marzucco, was a clear sign of the governmental orientation. Still, something was changing in the scientific culture of the mid-1780s. First of all, calculus finally entered the curriculum of the military schools. This fact can be seen as an attempt by the government not to "fall behind" in the crucial sector of military engineering. But why did this happen precisely in the 1780s, when in Northern Italian states the teaching of calculus had already been institutionalised for decades? I believe that the appearance of calculus in Naples can indeed be related to the cultural battle of the reformers. A particular reading of Newton's philosophy of nature enjoyed a great success in Naples since the 1730s. This reading was decidedly empiricist about the investigation of nature and voluntaristic in religious matters. The study of the calculus and the philosophical issue of the mathematisation of reality had had much less success[35]. In fact, since the 1730s onwards, apart from the brothers Martino and Vito Caravelli, no one had devoted his career to the production of original work in mathematics, nor even to up-to-date teaching. University courses were elementary and the military schools just added to their curricula what was strictly necessary for training engineers. It is not surprising that the generation of reformers which was active in the 1770s and 1780s lacked a good mathematical education. They, almost invariably, had been trained in one of the two most prestigious faculties, Law or Medicine. It is in the eighties that the relevance of the exact sciences to the administration of the modern state emerged as a well-defined issue. It had already been treated by Genovesi, of course, but in the eighties the reference was changed: reformers did not look any more to the first generation of the *encyclopédistes* but to the radical sensationalistic epistemology of Condorcet and to the algebraised calculus of Lagrange whose applicability to empirical reality seems more and more universal. By that time French scientific books circulated freely in Naples. In 1786 the government, led by the reformist Domenico Caracciolo, invited a group of French military engineers to re-organise the artillery of the kingdom on the basis of the French model. Reformers were indeed willing to modernise the teaching and research of mathematics not only by words. In 1781, Caracciolo had invited Lagrange himself to move to Naples, and to take the lead of the new RAS (1779)[36]. Caracciolo, who was a personal friend, would have known the work of Lagrange well. In the 1760s, during his stay in Paris as ambassador for the Kingdom of Naples, Caracciolo had enthusiastically embraced the arguments of the first generation of *encyclopédistes*, and he had been an admirer and a friend of d'Alembert. Caracciolo knew Lagrange in the 1760s, while he was in Turin. He soon realised that there were better places for the young mathematician than the Kingdom of Sardinia. It was indeed under Caracciolo's protection that Lagrange moved from Turin to Paris, where the well-known ambassador permitted him immediately to enter the drawing-rooms of the enlightened aristocracy. By 1781, when Caracciolo wrote to him, Lagrange had already moved to Berlin. As he explained in his answer, he was enjoying an extremely gratifying position, which he was not willing to leave.

In the early 1780s a young member of the class of mathematics of the new academy delivered three memoirs where he applied of integral and differential calculus to solve problems of practical interest for the state. This was afterwards the fundamental aim of the academy. His name was Nicola Fergola. He had been probably chosen as a member of the academy on the suggestion of Vito Caravelli, who had been informing the king of the more meritorious mathematicians. Caravelli himself published his textbook of calculus in 1786. In 1790 a private studio was opened in Naples where Lagrangian analysis was taught. It attracted a great number of young students willing to be trained as mathematicians, but lectures were attended also by well-known protagonists of the reformist movement, such as Mario Pagano. All this gave the impression that, by the mid-eighties, the cultural environment was ready for a serious modernisation of mathematical teaching and research. It would have been sufficient to look at the rich Northern Italian mathematical productions, which included good textbooks (such as the *Analytic Institutions* by Gaetana Agnesi, from Milan) and interesting applications of calculus to mechanics. As it turned out, this was not going to happen. In fact, an alternative option that could be taken in order to give new life to the study of mathematics in the kingdom was seen and adopted.

Before moving on to the events of the 1790s, which deeply shaped the cultural and social future of the kingdom, it is worth reflecting on the philosophical dimension of the Neapolitan reformism. I suggest this is best understood in terms of a fundamental epistemological shift. Traditional historiography has arguably been too keen to follow the history of ideas, and to look for sources and followers rather than focusing on the very specific problems reformers had in front of them. What seems crucial to the strategy of the reformers is rather the re-organisation they accomplished of the whole structure of knowledge, according to a new set of guiding principles and of new sources of legitimisation. In the new structure new branches of knowledge received legitimisation, whereas other branches were excluded. The very "way of thinking", or style of thought, which shaped the reformist texts presupposes —and in fact reinforces— the validity of a particular structure of knowledge, whose hierarchies and values were different from the traditional one. Describing the impossibility of radical technological innovations of production in the frame of the feudal-communal system of land I have suggested that we should think of technological devices as inserted in a network which includes other devices, administrative bodies, political institutions, economic interests and so on. A specific structure of knowledge must be part of the same network, as an essential cultural resource, a source of legitimisation which reinforce further the stability of the network. To test this working hypothesis we can begin by trying to define the features of the new structure of knowledge defended by the reformers.

The historian Ferrone has characterised what he call "the style of thought" of late Neapolitan reformism as "neo-naturalism"[37]. He has rightly pointed out that most of the production of the second generation of Neapolitan reformers, such as Filangieri, Pagano, Grimaldi, Cirillo, and Longano was shaped by their Masonic experience. Doctrines from the Hermetic tradition circulated in the twenty or so Neapolitan lodges, such as the metaphor of the universe as an animal, pantheism, cyclical conceptions of time, and the dislike for mechanist reductionism. It was often the case that similar doctrines could be traced back to the roots of Southern Italian Renaissance naturalism, whose re-emergence has already been signalled in the years of the fight against the Cartesians. In Ferrone's reconstruction, late Neapolitan reformism was founded on a renewed version of Renaissance naturalism, which can be interpreted as a pessimistic reaction to the failure of the earlier reform programs. This failure put in question many previous assumptions, such as that of history being a progressive process, or the very possibility for Southern society to escape its destiny of backwardness and inequality. Themes such as the circularity of time, the catastrophic evolution of the Earth, the inevitable decadence of civilisation enjoyed great popularity among the late reformist writers, and can be related to the declining belief in the real possibility of modifying a state of things that seemed more and more unchangeable. The reference to this cultural stream, and to its main places of elaboration, the masonic lodges, can help to put in context the historicistic perspective shared by many reformers and its tendency to subsume the evolution of the physical and mathematical sciences under historical categories. It also helps us to make sense of the Vico-revival which took place in those years. But then Ferrone goes also on to include under his descriptive concept of neo-naturalism the scientific productions of the period. In particular, he consider as neo-naturalistic the mathematical project of Nicola Fergola and of his influential school of geometry. Fergola and his pupils are classified as neo-naturalists on the basis of their declared anti-reductionism in the natural sciences, and their dislike for the productions of the contemporary French *géomètres*, particularly for the philosophical writings of Condorcet and the mathematical writings of Lagrange. By this stage the descriptive concept of neo-naturalism has became like that night where all cows are black. Too many and too various phenomena are being grouped under its label. This suggests that the concept is not a very useful tool for the cultural historian. As we shall see by analysing the writings of Fergola, his whole cultural project, which included his approach to mathematics, was precisely *at odds* with the social program and the philosophical perspective of the reformers. To let this crucial opposition emerge more clearly, we can make use of the notion of the "structure of knowledge" (without attributing to it any sort of explanatory power, though).

Let us begin by noting that the whole reformist front did not, in fact, share this supposedly neo-naturalistic, i.e. non-mathematical character. In reformist writings we can find optimistic statements about the "calculability" of things. Genovesi himself, a convinced Newtonian, declared he was mainly interested in discovering the "true laws of politics and economics". In his mind "politics, like economics, has its own certain and eternal principles: thus it has its own theorems and its own problems"[38]. It was precisely the definition of such universal and rational laws which enabled Genovesi to attack the feudal social setting and the juridical system, whose complexity openly favoured the landed aristocracy in its quarrels with local communities. As Genovesi pointed out, the system of law was functional to maintain a *status quo* which was irrational, i.e. not based on the universal laws which must define a rational administration, but on an illegal action, namely the acquisition of feudal rights during the Middle Ages. Indeed, some of Genovesi's students gave primary importance to the definition of a set of laws to re-organise the political and economic life of the kingdom on a rational basis, which they saw as the universal laws which should regulate every human society[39]. So it is a fact that in spite of the neo-naturalistic tone of much reformist production, we can also find crucial themes and styles of thought which were much closer to the contemporary encyclopaedic project of the *philosophes*, where the "spirit" of the exact sciences (theorems, rational deduction, universal laws), was employed as a resource to make sense of social and political reality and to project its modification.

Consider now the second generation of reformers. Gaetano Filangieri founded his monumental work on the science of legislation, probably the most influential text of the late reformism, on his belief in a rational order of nature:

> no man can ignore his own laws [...]. These are the dictates of the principle of universal reason, of the moral sense that the Author of nature has impressed on every individual of our kind, as living measure of justice and honesty, which talk to the whole mankind with the same language and has always prescribed the same laws in every time [...]. [40]

"Our redemption" Filangieri wrote in another work, can only arrive "from the progresses of public education", and on this point he openly criticised the militaristic choices of the Minister of the Navy, and of the monarchy itself, which absorbed too large an amount of material and human resources (remember the moving of the best mathematicians from the university to the academies). Such criticisms were part of a large anti-despotic campaign which emerged clearly in the late 1780s, inside the Southern freemasonry, as the trust in King Ferdinando IV was fading away. The principles of the new-born American democracy were widely debated in the lodges. In fact Filangieri was in correspondence with Benjamin Franklin[41]. Despotism, militarism, feudalism, are the "monsters" attacked by Filangieri and by other members of the Neapolitan "brotherhood" in the name of the "social harmony" which should derive from following the "natural and eternal laws" of man and society. It is indeed false, Filangieri claims, that the science of legislation has no fixed principles, and that "the only rule of legislation is the will of the legislator". It is certainly true that "the state is a complex machine: the wheels that compound it are not always the same, and the forces that make them move are different" (notice the mechanistic metaphor), but this does not mean that "the rules which let us know the different wheels and the different forces cannot be always fixed and constant". The science of the social order cannot lack certain principles, it cannot be "vague and uncertain" [42]. Filangieri died still young in 1788. In 1786 he had taken part in the foundation of the egalitarian lodge of the *Illuminati*, founded in Naples in occasion of the visit of the Danish theologian Friedrich Münter (1761-1831). A few months later Filangieri had met the "brother" Wolfgang Goethe, with whom he agreed about the despotic nature of the government of Joseph II Habsburg and of Ferdinando IV[43]. In his *Éloge of Filangieri* (1788), the fellow-reformer (and "brother") Donato Tommasi pointed out that Filangieri was working to the creation of a whole system of knowledge, the "new science of the sciences", which should be able to explain the particular history of the nations as well as the general history of man. This is described as an anti-scholastic system, were the sciences do not deal with the essences of things, but rather with the relations among them; and every science would be linked to any other, because "all the truths are connected" to form "a chain". The universal chain of truths is the object of the science of the sciences, of which the science of legislation is a part. At this point the masonic nature of Filangieri's project becomes clear: the search for "harmony" is what lies behind his investigation of the "chain of truths", which will end up with the construction of "the science of the sciences". The new society resulting from the "regeneration" will be a society of equal and fully educated men, a society "senza volgo" (without low people). In Filangieri this social utopia, like the quasi-mystical term "regeneration", reflected the masonic doctrines and the religious tones in which the ambitions of specific social groups were encoded. Just a couple of years after Filangieri's death, this same utopia and the same word "regeneration" was to enter the doctrinal apparatus of the much more aggressive Jacobin movement. We have no reason to believe that they were expressions of different interests, and the elite nature of Neapolitan Jacobinism confirms this hypothesis[44].

Mario Pagano was the other great figure of Neapolitan reformism. Professor of Criminal Law and a freemason himself, he was not from an ancient aristocratic family of the capital as was Filangieri, but more of a provincial self-made man. In his *Political Essays*, firstly published in 1783-85 and reprinted in the early nineties 1791, he was mainly interested in the construction of a reliable method to collect circumstantial evidence. The method has to deal with the natural laws, and Pagano states that

> nature does not delude and does not deceive anyone. The immutable relations of things are not subject to human corruption. Moral laws are as constant and necessary as the physical laws. The judge's mind is forced by witnesses, whereas it is convinced and persuaded by circumstances.[45]

Following the results of the scientific investigations of his "brother" and famous physician Domenico Cirillo, Pagano recognised the validity of a fundamental methodological principle: there is no essential difference between the laws of the physical universe and the laws of the moral universe. Indeed, the main reason for the lack of advancement in the moral sciences is precisely the lack of understanding about this point.

> Considering differently the laws of the physical world and those of the moral world we have been separating the sciences and the knowledge which should be treated along with them; so both remained dry and imperfect, and the most interesting have been less treated.[46]

The fact that the study of history, of language, of nature, of antiquity do not share the same principles make them superficial and emblematic of a period of decadence, where the real fundamental and unitary truths are covered by ignorance and error. The belief that there are constant and necessary moral and physical laws, plus the confidence in the possibility of their re-discovery in order to "regenerate" the corrupted humanity, are the basic tenets of Pagano's masonic science. Natural laws being essentially similar to moral laws, Pagano reads the history of the world as a succession of parallel physical and political revolutions, articulating a new version of the old cyclical cosmological model of progress and decadence (recall his usage of the 1783 earthquake). In the background, was the image of an immutable and harmonic natural order.

> Nature, though always changing, is always the same. The force that moves and gives life [*anima*] to everything, and the matter of which everything is made are always the same. Still the old forms of things change, and are followed by new ones. So that nature, reproducing itself, always assumes new appearances. [...]. The innumerable phenomena are just different ways in which that power operates which pervades everything. So nature changes in every moment, but in its essence it is always one and the same.[47]

Turn now to the scientist whose work inspired Pagano, Domenico Cirillo. A second generation reformer of Genovesi's school and a freemason since the 1770s, Cirillo was a leading physician, botanist and entomologist. He was Professor of Botany (1759-1789) and of Practical Medicine (1789-1799) at the RUN, and a member of many European academies, including the Royal Society of London. He had regular correspondence with Voltaire, d'Alembert, Diderot and he was particularly interested in Rousseau's egalitarian ideas. His critical reflections on the present state of the Neapolitan socio-political situation were published —with a false indication of place, under the apparently neutral title of *Academic Speeches*[48]. An early follower of Lavoisier in chemistry, Cirillo devoted most of his experimental work to the study of the physiology of plants, where he attributed a central role to the "vital fluid [i.e. oxygen]" that is the "fundamental support of life". He also introduced in Naples Linneus' system of classification, which he applied to the flora of the kingdom. As we noticed above, his fellow reformers Pagano and Filangieri found his experimental work interesting particularly for its general perspective, where Cirillo do not trace any clear cut distinction between the sphere of the moral and the sphere of the physical. Consider, for instance, the passage of the *Speeches* where he explains the universal feeling of compassion for our suffering fellow-humans by reducing it to the particular physical constitution of human beings, which is in turn explained on the basis of the universal principle that "nature has the essential attribution of maintaining peace and equality among its creatures, and it is perturbed by the presence of misery, by the expression of sorrow". So that our "pure spiritual affections" (in this case compassion) are "strictly linked to the body and to inert matter".

Similar ideas will be re-elaborated by the provincial reformer Melchiorre Delfico (1744-1835). Delfico was probably not the most coherent thinker in Genovesi's school and not even the most original, but his activity was exemplary of the relations between the reformist authors and the central government; moreover, he was to exercise a deep influence on the Neapolitan *ideologists*[49] of the turn of the century. Delfico's work has been taken as the crucial link between the Lockean empiricism and the early sensationalism of Genovesi's school and later forms of sensationalism and *ideology* which were to be current in Naples until the Restoration[50]. Delfico was personally involved in the reformist programs of the 1780s, to which he contributed with a number of works on practical questions such as the reform of the army, the changes in agricultural and breeding techniques, the trade legislation (in favour of a free-trade policy), and the abolition of the feudal system[51]. Later on, his interests moved to the philosophical foundations of reformism. The tenor of these theoretical productions can be grasped by looking at the titles of his publications and speeches, which include *Thoughts on History and on its Uselessness and Uncertainty*, *Remarks on the Real Foundations of the Moral Sciences*, and *On the Necessity for Physiological Knowledge to Precede the Study of Intellectual Philosophy*[52]. Delfico's publications were was mainly devoted to showing how intellectual and moral spheres are always —in principle— reducible to physiological processes. He applied this philosophical perspective to a number of questions he worked on during his long active life, including the reform of the juridical system, moral philosophy, pedagogy, and aesthetics. Delfico's interests and conclusions are very close to those of contemporary French *ideology*; indeed, when he firstly read Cabanis in the early years of 1800, he recognised in the French *ideologist* an ally fighting the same cultural battle as his own[53]. He was also in correspondence with Destutt de Tracy, who declared himself a "disciple" of the Neapolitan. Later on, Delfico referred to his own work as part of that stream of thought which had originated from "the principles of Locke's philosophy, and which has been extended and brought to its most useful application by Condillac, Bonnet and Tracy, and embraced by the most loyal friends of reason". In his book against the authority of Roman Law, Delfico's radical anti-historicism is the basis for a critique of the extremely conservative juridical system of the Kingdom of Naples, where not less than five different legislations were contemporaneously in force, as a result of historical stratification[54]. The habit of legislating *more maiorum* is irrational, Delfico wrote, and must be rejected because it is an inexhaustible source of confusion and of abuse. Rather, the universal features of human nature should be taken as the foundations of society and of its legislation. According to Delfico, the organic constitution of human beings is the real cause of their social nature, as of every moral phenomenon in general. And this belief is not affected by the recognition that "the natural sciences are not yet so advanced as to shed light on the physical principles of the intellectual sphere and of the morals"[55]. This reductionist belief lies behind every stance taken by Delfico, such as his conclusion that humanity is certainly perfectible (given that social nature is based on a sort of organic disposition). This perfectibility included goals as women's emancipation and universal peace[56]. Legislation must be founded on the common organic constitution of human beings, and this means that there should be a single rational legislation for the entire human race (in opposition to Montesquieu's idea of specific constitutions for each specific people), i.e. the same conclusion already drawn by Gaetano Filangieri in 1780[57]. Delfico's anti-historicism is more radical than Fontenelle's or d'Alembert's, and was probably stimulated by the reading of the *ideologist* Volney, who defined history as "l'une des sources les plus fécondes de leurs préjugés et de leurs erreurs"[58]. The radicalization of Volney's judgements is accomplished by Delfico arguing for the intrinsic incertitude and absolute uselessness of history, where the French had defended the utility of historical considerations at least in the field of politics. Note that Delfico grounded his argument on the recognition that "the elements of history are complex, shifting and uncertain", and for this reason they cannot be made objects of calculation[59]. Experimentation and observation as they are accomplished in the natural sciences are not possible in history. And Delfico is not claiming here that history has different but equally legitimate methods for its investigation; he is claiming that *history is not a source of reliable knowledge at all*, and consequently it should be eliminated from university curricula. Significantly, he dedicated his *Thoughts* to "the students of the natural sciences", who are "the investigators of the truths most useful to man and the real opponents of the most powerful prejudices and errors". A remarkable thesis of the book is the sensationalistic foundation of morals (through the discovery of a necessary connection between the ideas of pleasure, moral good, and virtue) on which, in turn, the science of politics must be founded. It is clear that if our knowledge of morals and politics have to be founded "on physiology and on other physical knowledge", then history cannot be regarded as relevant for their advancement. The only guides, in these fields as everywhere else, must be "analysis, experience and observation". In Delfico's sensationalistic framework, the source of certainty in human knowledge is to be found in sensations: their *reality* is somehow transmuted into the *evidence* of the corresponding ideas, and this evidence is the origin of *certainty* in human knowledge[60]. As a result, certain beliefs can only be originated from direct sensation. The *Thoughts* end with a reference to the history of science, which is reduced to the exhibition of the proper method of invention and to the analytic presentation of physical truths. Delfico also renews his appeal to the "physicists", because the knowledge of reality and of "real causes" is in their hands alone. The neo-idealist historian Gentile remarked that the Delfico's *Thoughts* have "scarcely any theoretical value", but he admitted that they played a "remarkable" role in the history of philosophical thought, as is proved by their many editions[61]. Also influential were Delfico's ideas on pedagogical matters. In a memoir read at the RAS in 1813, he deepened his early thesis about the sociability of human beings arguing that civilisation itself has physiological foundations, which he described as "imitative sensibility"[62]. This is a supposedly fundamental phenomenon of animal physiology, which is originated by the organic interplay between sensory organs (mainly those of sight and hearing) and the central nervous system ("internal sensibility" as Delfico calls it). Referring to this model of mechanical imitation of external inputs, Delfico explained phenomena such as the birth of language among primitive populations. Language arises naturally from the human physical constitution, it is not the result of some artificial convention, as maintained by Rousseau and Adam Smith. On the basis of a similar "principle of imitation", Mario Pagano had already explained not only the origin of language, but also those of dance and music[63]. Evidently Pagano's attraction for Vico and for Hermetic philosophies of history did not prevent him from providing physiological explanations for "moral phenomena". Delfico became even more radical when he extended his considerations from primitive language to narrative, works of art and religious rituals. In the end, the mechanism of imitation was recognised as the basis of morals themselves, the imitative sensibility being the foundation of a "physical sympathy" which in turn is the organic cause of the feeling of compassion, which is simply a "disposition of the [human] machine". If morals and civilisation derive from the organic mechanism of the imitative sensibility, then it is possible to operate on this latter in order to modify and improve the moral qualities of pupils, according to the principle that "habits are more the effect of sensations than of ideas"[64].

Delfico was active until the mid-thirties, but by that time new issues were emerging in the philosophical debate, and he remained an authoritative but isolated figure. The last representatives of the "spirit" of Delfico's sensationalism were Pasquale Borrelli (1782-1849) and Francesco Paolo Bozzelli (1786-1864). Borrelli was a physician and a lawyer, and his out-put includes poems, pieces of mathematics and philosophical essays[65]. He actively supported the French government (1806-1815) and was minister of police within the constitutional government of 1820-1821. Afterwards he was exiled. Borrelli had been a student of Domenico Cirillo since 1798, and a defender of the ideas of John Brown, as it emerges from his first book on physiology (1803), where he presented *more geometrico* the work of the Scottish physician[66]. Borrelli was indeed interested in the possibility of applying mathematics to animal physiology, and this is the topic of his *Principles of Zooarithmy*, a study "in the modern mathematical medicine"[67]. According to Brown, "life" is the result of the presence of "organic force" (i.e. irritability of the muscular tissue and sensibility of the nervous system) and of its reaction to stimulation. Borrelli believed that such organic force, or excitability, coincided with Cabanis' notion of sensibility, and consequently he saw the possibility of reducing *ideology* ("the process of mental operations") to its physiological basis ("the organisation of man"). The materialistic implications of a similar project are quite evident, as is its rigid determinism when it comes to the question of human freedom. At least, they were evident to the scrupulous Bourbon censorship. The formal postulation of an immaterial soul was plainly superfluous, once he has already made sense of every mental process by means of organic processes. The *ideological* part of Borrelli's work concerns the origins of ideas[68]. Here he proceeded by the method of analysis: the analysis of ideas (their "resolution") brings us to the surface their own genesis. Locke, Condillac, Bonnet, Tracy, Erasmus Darwin and Cabanis are the "empiricists" whom continuously Borrellli opposes to the "rationalistic" philosophies of Descartes, Leibniz and Kant, which he had read in their original versions during a staying in Germany. A "physiological *ideology*" should be, according to Borrelli, the goal of a new generation of *ideologists*, given that our knowledge of the real functioning of intellectual operations is still in need of much elaboration. Among the reasons for the stagnation of *ideological* studies, he points to the lack of a common and clear philosophical terminology. He also highlights the lack of a proper system of classification for the "acts of the soul [*atti dell'anima*]", on the model of Lavoisier's classification of chemical elements. Indeed, Lavoisier's new chemistry is probably behind the request for a new terminology as well. In particular Borrelli makes clear that memory cannot be considered as an autonomous, elementary faculty of the soul, and so it should not be employed in our classification of knowledge (this divergence from the French *encyclopédistes* was a typical feature of Neapolitan Jacobin thought). Another crucial point of Borrelli's ideological theory is that no lack of continuity must exist between *ideology* and the natural sciences: *ideology* must be scientific and sciences must be founded on *ideology*. This is not yet the case, Borrelli remarks, and this is indeed another reason for the present problems of *ideology*. The request for a fusion of *ideology* and natural science is grounded on the belief that the "science of the soul" should not be isolated from the works of physicists, to be founded only on the introspection of conscience, as maintained by the Scottish Dugald Stewart. Instead, even if soul and body are certainly different (one is extended and compound, the other is not extended and simple), they have relations which can be studied and described as laws, and this makes necessary the contemporary study of the two dimensions.

Bozzelli can be placed in the same stream of thought. He was particularly interested in extending Borrelli's considerations to the dangerous field of morals. Morals should be transformed into a real science, characterised by rigor and systematic coherence. Moving from sensationalistic premises, Bozzelli concludes that the real foundation of the morals is, in the end, the perspective of a pleasant future. The normative nature of morality is thus rejected in favour of a purely hedonistic perspective. He was not saying that moral laws are arbitrary; rather they originate in the "human spirit", and from the properties of human organic nature. Bozzelli can thus claim that they are intrinsic to human beings as physical laws are intrinsic to natural bodies. Note the conclusion: our knowledge of moral laws enjoys exactly the same status as our knowledge of physical laws. Like Borrelli, Bozzelli was involved in the constitutional insurrection of 1820-21; following the

Bourbon repression he was exiled, and he settled in Paris. He was to be minister of the interior in the 1848 Neapolitan revolutionary government[69].

Our selection of Neapolitan authors included first-rate reformers such as Filangieri, Pagano, Cirillo, Delfico, as well as later *ideologists* such as Borrelli and Bozzelli. Roughly, we have been moving from the 1780s to the 1820s. Other names and works could be added, but one point should already have emerged quite clearly. In spite of their various interests, the authors linked to the reformist movement of the late eighteenth century, and their early nineteenth century followers, can be consistently grouped on the basis of a common aim: the elimination of any essential distinction between the nature of explanation in natural sciences and in the moral and social sciences. Epistemologically, this meant that knowledge about morals and about society enjoyed the same status as scientific knowledge, both originating from the investigation of empirical phenomena (human mental processes in the one case, and physical bodies in the other). Methodologically, this meant that the investigation of empirical phenomena, be they natural or moral, should be unified under one and the same approach. This approach has been differently described by different authors; yet everyone agreed that the study of mental processes (i.e. *ideology*) and the study of natural phenomena should be performed by means of the "analytic method", where "analysis" refers roughly to the resolution of complex ideas and natural phenomena to their elementary constituents. Studying these elements and the range of their possible combinations would enable the philosopher-scientist to discover the real laws of both the natural and the moral world. *Sensible perceptions* and the *analytic method* are thus the key-points of any investigation whose goal is to produce sound – i.e. legitimate – knowledge. The knowledge of the moral world is assimilated to the knowledge of the natural world in the new "structure of knowledge" of the reformers. At the same time super-natural knowledge, metaphysical and religious, is de-legitimated. It is expunged from the realm of sound knowledge. The only reliable sources of knowledge are our senses and our natural reason. No knowledge can be legitimate if it is not their product. While metaphysical questions are simply considered irrelevant, religious beliefs are excluded from maps of knowledge, being attributed to the sphere of individual consciousness.

Far from being homogeneously non-mathematical as maintained by Ferrone, Neapolitan reformers perceived mathematics and the mathematical style of reasoning as a powerful cultural resource for their battle. In particular, those more informed about mathematical development abroad, like Caracciolo, perceived the potential support that their cultural and social projects could obtain from a specific style of mathematical reasoning that was increasingly popular in France and Northern Italy, but that was certainly not common in Naples: namely the analytic style. It was indeed in connection with the implementation of the reformist plans of the 1780s, that thinkers in Naples perceived the backwardness of the local mathematical teaching and felt the need for a sudden re-alignment with the French *geometres*, particularly through the works of Lagrange. This "modernisation" of mathematics was perceived as crucial by men who were not mathematicians themselves, mainly because they were aware that what could be imported with the new mathematical knowledge was a new "way of thinking", which was also a new "way of acting", a savoir-faire. The practitioners who actually brought the analytic style into Naples were looking at France with very much the same expectations that Genovesi had when he imported Lockean empiricism from England. Only, this time, they were convinced of the necessity of a much more radical confrontation with the present system of power.

Notes to chapter two

[1] The dynamics of ideas has been traditionally privileged in historical accounts of the Enlightenment; even in those more sensible to the social and cultural dimensions, such as Peter Gay, *The Enlightenment: An Interpretation*, 2 vols. (New York: Random House 1966 and 1969), or Franco Venturi (ed.), *Illuministi italiani. Vol. 5: Riformatori napoletani* (Milan-Naples: Ricciardi, 1962). By Venturi see also Franco Venturi, *Settecento riformatore*, 2 vols. (Turin: Einaudi, 1969 and 1970); in English, see Franco Venturi, *Italy and the Enlightenment. Studies in a Cosmopolitan Century* (London: Longman, 1972). In the same tradition see Vincenzo Ferrone, *The Intellectual Roots of the Italian Enlightenment. Newtonian Science, Religion and Politics in the Early Eighteenth Century* (New Jersey: Humanities Press, 1995).

[2] See Amodeo, *Vita matematica napoletana*, vol.1, p.68.

[3] Antonio Genovesi, *Discorso sopra il vero fine delle lettere e delle scienze* (1753), in Antonio Genovesi, *Scritti* (Turin: Einaudi, 1977) p.41.

[4] Genovesi, *Discorso*, pp.44-45.

[5] Ibidem, p.53.

[6] Ibidem, p.56.

[7] Antonio Genovesi, *Lettere accademiche su la questione se sieno più felici gl'ignoranti che gli scienziati* (Varese: Sugarco, 1993; ed. orig. 1764) p.82.

[8] Venturi, *Italy and the Enlightenment*, p.201.

[9] Antonio Genovesi, *Lezioni sul commercio*, 2 vols. (Naples: 1765 and 1767). Excerpts in Genovesi, *Scritti*, pp.133-207.
[10] Genovesi, *Lezioni sul commercio*, p.207.
[11] And also Giuseppe Palmieri (1721-1794), Filippo Briganti (1725-1804), Domenico de Gennaro (1720-1803), Francesco Antonio Grimaldi (1741-1784).
[12] On the reform of the army, indeed one of the most significant and successfull reforms, and on its cultural and social meaning, see Anna Maria Rao, "Esercito e società a Napoli nelle riforme del secondo Settecento", *Studi Storici*, 1987, 28:623-677.
[13] For a selection of writings on policy, economics, legislation and administration by Neapolitan reformers see Venturi, *Illuministi italiani: riformatori napoletani*; and Francesco di Battista (ed.), *Il mezzogiorno alla fine del Settecento* (Bari: Laterza, 1992).
[14] Domenico Grimaldi, *Istruzioni sulla nuova manifattura dell'olio introdutto nel Regno dal Marchese Domenico Grimaldi* (Naples: 1781).
[15] Domenico Grimaldi, *Piano di riforma per la publica economia delle provincie del Regno di Napoli e per l'agricoltura delle Due Sicilie* (Naples: 1780).
[16] Venturi, *Italy and the Enlightenment*, p.206.
[17] For a presentation of the Neapolitan feudal communal system of land in the late eighteenth century see Patrick Chorley, *Oil, Silk, and Enlightenment. Economic problems in XVIIIth Century Naples* (Naples: Istituto Italiano di Studi Storici, 1965).
[18] Grimaldi, *Istruzioni*, p.60.
[19] Domenico Grimaldi, *Memoria per il ristabilimento dell'industria olearia nelle Calabrie* (Naples: 1783) p.35.
[20] Domenico Grimaldi, *Relazione umiliata al Re d'un disimpegno fatto nella Ulteriore Calabria*, (Naples: 1785) p.40.
[21] The network metaphor has a long tradition in the philosophy and sociology of science. It has been employed by Duhem, Quine and, more extensively, by Mary Hesse, *The Structure of Scientific Inference* (London: Macmillan, 1974). More recently it has been re-elaborated in Bruno Latour, *Science in Action: How to follow Scientists and Engineers through Society* (Milton Keynes: Open U.P., 1987), and in his following works. In this context, it is employed in a rather intuitive way.
[22] Giuseppe Palmieri, *Osservazioni su vari articoli rigurdanti la pubblica economia* (Naples: 1790).
[23] Carlo Ulisse de Salis Marschlins, *Nel Regno di Napoli. Viaggi attarverso varie provincie nel 1789* (Lecce: Congedo, 1979; orig.ed. 1793) pp.40-41.
[24] Palmieri, *Osservazioni*, p.99.
[25] See, for instance, Palmieri, *Pensieri*, p.8; and Grimaldi, *Osservazioni*, p.19.
[26] Eighteenth-century Neapolitan freemasonry is described in Carlo Francovich, *Storia della massoneria in Italia dalle origini alla Rivoluzione francese* (Florence: La Nuova Italia, 1990). See also Aldo Mola (ed.), *La massoneria nella storia d'Italia* (Rome: Atanòr, 1980); and Giuseppe Giarrizzo, *Massoneria e illuminismo nell'europa del Settecento* (Venice: Marsilio, 1994). On the relations between European freemasonry and eighteenth-century socio-political reformism see Margaret Jacob, *The Radical Enlightenment. Pantheists, Freemasons and Republicans* (London: Allen and Unwin, 1981); and Margaret Jacob, *Living the Enlightenment: Freemasonry and Politics in Eighteenth-Century Europe* (Oxford: Oxford U.P., 1991). But see also the critical remarks on Jacob's interpretation in Graham Gibbs, "The Radical Enlightenment", *British Journal for the History of Science*, 1984, 17:67-81.
[27] Francesco Antonio Grimaldi, *Riflessioni sopra l'ineguaglianza tra gli uomini* (Naples: 1779); Gaetano Filangieri, *La scienza della legislazione* (Naples: 1780-83); Mario Pagano, *Saggi politici de' principi, progressi e decadenza delle società* (Naples: 1783-85); Mario Pagano, *Considerazioni sul processo criminale* (Naples: 1787).
[28] The *Illuminati* was a masonic association founded in 1776 in Ingolstadt, Bavaria, by Adam Weishaupt (1748-1830), professor of law at the local university. Its adherents supported the party of the *Aufklärung*, which was decidely minoritarian in the Catholic and baroque Bavaria. The *Illuminati* played an important role in the anti-clerical and anti-Jesuit campaign. Their principles were inspired by Holbach's materialism, Rousseau's egalitarianism and, in religious matters, by deistic authors. The "regeneration" of mankind would be achieved,

according to the *Illuminati*, through the practice of a renewed morals and through the diffusion of scientific knowledge. Lodges of *Illuminati* were opened in a number of towns of the Aurtrian empire, including Vienna, Prague, Innsbrück, and Milan. Around 1783, when Goethe and Herder enter the association, the *Illuminati* were characterized by their opposition to "despotic" political regimes, including the Bavarian one. Opposed by governements, and by rival, mystically-oriented masonic associations such as the order of the Golden Rosicrucians, the German *Illuminati* were persecuted and dispersed in 1785. But some of the foreign lodges were still functioning in 1789. The Neapolitan lodge had been founded in 1786, by former members of the *Gran Loggia di Napoli*, which dated to the early 1770s, and which followed the "Scottish rite", opposing the penetration of the mystically-oriented lodges inspired to the "Strict observance". Most of the Neapolitan reformers and Jacobins were members of the *Gran Loggia* and, later, of the lodge of the *Illuminati*. Freemasonry was already diffused in Naples around 1750. In fact, the papal bull *Providas* (1751, where freemasonry was openly condemned) was emanated by Pope Benedetto XIV as a directed response to the Neapolitan situation, forcing the Neapolitan soveregn to intervene more drastically. In fact, it was only after the Bavarian trials of 1785, when the eversive political goals of the *Illuminati* emerged clearly, that freemasonry declined, in Naples as everywhere else in Europe. The alliance between monarchies and the Church against the *Illuminati* was a prelude to the "throne and altar" politics of the Restoration. On the *Illuminati* see René Le Forestier, *Les Illuminés de Bavière et la franc-maçonnerie allemande* (Paris: 1928); and Carlo Francovich, "Gli Illuminati di Weishaupt e l'idea egualitaria in alcune società segrete del Risorgimento", *Movimento Operaio*, 1952, 4:553-597.

29 On the numerous philosophical and scientific productions inspired by the 1783 Calabrian earth-quake, and on their social and cultural significance, see Augusto Placanica, *Il filosofo e la catastrofe. Un terremoto del settecento* (Turin: Einaudi, 1985).

30 Quoted in Venturi, *Italy and Enlightenment*, p.219.

31 John Francis Edward Acton, from an English family which had moved to France for religious reasons, was educated in Italy (Pisa), and was at the service of the Grand Duke of Tuscany (1767-1778), as captain in the navy. In 1778 he was invited in Naples, to re-organize the Bourbonic fleet. In 1782 he was nominated minister of war and, at the death of Caracciolo, he became prime minister (1789-1795). On Acton see Harold Acton, *The Bourbons of Naples, 1734-1825* (London: Methuen, 1956); see also his biography in *Dizionario Biografico degli Italiani*, sub voce.

32 Nicola Fiorentino, *Riflessioni sul Regno di Napoli* (Naples: 1794).

33 Quoted in Venturi, *Italy and Enlightenment*, p.222.

34 Vito Caravelli and Vincenzo Porto, *Trattato di calcolo differenziale di Vito Caravelli, e del calcolo integrale di Vincenzo Porto, per uso del regale collegio militare* (Naples: 1786).

35 On the penetration of Newtonianism in Naples see Ferrone, *The Intellectual Roots of Italian Enlightenment*, pp.183-247.

36 See Lagrange's response to Caracciolo in Lagrange, *Oeuvres*, vol.14, p.279-282. On the reformist aims of the renwed RAS see Elvira Chiosi, *Lo spirito del secolo. Politica e religione a Napoli nell'età dell'illuminismo* (Naples: Giannini, 1992) pp.107-142.

37 Vincenzo Ferrone, *I profeti dell'illuminismo. Le metamorfosi della ragione nel tardo settecento italiano* (Bari: Laterza, 1989).

38 Antonio Genovesi, *Logica per gli giovinetti* (1766), in Genovesi, *Scritti*, p.232.

39 The most famous work in this direction was Filangieri, *La scienza della legislazione*.

40 Filangieri, *Scienza della legislazione*, quoted in Giarrizzo, *Masssoneria e illuminismo*, p.280.

41 See Giarrizzo, *Massoneria e Illuminismo*, p.281.

42 Quotations from Filangieri, *Scienza della legislazione*, in Giarrizzo, *Massoneria e illuminismo*, p.290.

43 Giarrizzo, p.284.

44 On the presence of mysticism in the culture of the late eighteenth century, and on the mystic freemasonry, see Auguste Viatte, *Les sources occultes de Romantisme. Illuminisme-Théosophie, 1770-1820* (Paris: 1928). On the social meaning of these mystic trends see Renzo de Felice, *Note e ricerche sugli "Illuminati" e il misticismo rivoluzionario, 1789-1800* (Rome:

E.S.L., 1960). Note that de Felice used the term "illuminati" to refer to the eighteenth-century visionaries, not to the homonymous association founded by Weishaupt, which was in fact far from being mystically oriented.

[45] Quoted in Giarrizzo, p.351.

[46] Quoted in Giarrizzo, p.352.

[47] Idem.

[48] Domenico Cirillo, *Discorsi accademici* (Nice [Naples]: 1787); a new and more complete edition was published in Naples in 1799, under the republican government.

[49] The word "idéologie" was coined by Antoine Louis Claude Destutt de Tracy (1754-1836) in 1796, meaning "the science of ideas". See Destutt de Tracy *Éléments d'idéologie* (Bruxelles: 1804-1818). Other crucial texts of the *idéologie* were those by Pierre Jean Georges Cabanis (1757-1808), particularly his *Rapports du physique et du moral de l'homme*, 2 vols. (Paris: 1796-1802). The doctrines of the *idéologues* found enthusiatic supporters in the Italian states, particulalry among reformers and Jacobins; nevertheless there are no studies on the diffusion of *idéologie* in Italy. On the thought of the French *idéologues* see the classic Joseph-François Picovet, *Les idéologues. Essai sur l'histoire des idées et des theories scientifiques, philosophiques, religioeuses, etc., en France depuis 1789* (Paris: 1891). The most complete reconstruction of the thought of the *idéologues* is Sergio Moravia, *Il pensiero degli idéologues: scienza e filosofia in Francia, 1780-1815* (Florence: La Nuova Italia, 1974). See also Emmett Kennedy, *A Philosophe in the Age of Revolution: Destutt de Tracy and the Origins of "Ideology"* (Philadelphia: American Philosophical Society, 1978); Brian Head, *Ideology and Social Science: Destutt de Tracy and French Liberalism* (Dordrecht: Nijohff, 1985); Martin Staum, *Cabanis: Enlightenment and Medical Philosophy in the French Revolution* (Princeton, Princeton U.P., 1980). In the following, the term *idéologue* and *idéologie* will be rendered with *ideologist* and *ideology* (in italics).

[50] See Giovanni Gentile, *Storia della filosofia italiana dal Genovesi al Galluppi* (Milan: 1930) pp.25-120.

[51] See a complete list of his writings in Raffaele Liberatore, "Necrologia di Melchiorre Delfico", *Il Progresso*, 1835, 11:292-318.

[52] Delfico, *Pensieri sulla storia e su la incertezza ed inutilità della medesima* (Forlì: 1806), reprinted in Naples in 1809 and 1814; the others are memories sent to the RAS after 1823 (cited in Gentile, *Storia della filosofia italiana*, p.45).

[53] Delfico praised Cabanis's *Du degré de certitude de la médecine* (Paris: 1797); see Delfico, *Pensieri*, p.151.

[54] Melchiorre Delfico, *Ricerche sul vero carattere della giurisprudenza romana e de' suoi cultori* (Napoli: 1791).

[55] Melchiorre Delfico, *Memorie storiche della Repubblica di San Marino* (Milan: 1804) p.239.

[56] The belief in human perfectibility emerged already in the 1791 work on Roman Law, few years before the publication of Condorcet's *Esquissee des progrès de l'esprit humain*, where the indefinite perfectibility of mankind is defended.

[57] "I call *absolute goodness* of laws their harmony with the universal principles of morals, which are common to every nation, to every government, and adaptable to every climate. The right of nature contains the immutable principles of what is right and equitable in every case. It is easy to see how this souce is fruitful for the science of legislation. No one can ignore its laws. They are neither the ambiguous results of the precepts of the moralists, nor the results of the sterile meditations of philosophers" (Filangieri, *Scienza della legislazione* , quoted in Gentile, *Storia della filosofia italiana*, p.59).

[58] Constantin Francois de Chasseboeuf (Volney), *Leçons d'histoire prononçées à l'École Normale en l'an III de la République française*, in: Volney, *Oeuvres complètes*, vol.6 (Paris: 1843) p.v.

[59] Delfico, *Pensieri*, p.144 and following.

[60] Ibidem, p.41.

[61] See Gentile, *Storia della filosofia italiana*, p.88.

[62] Melchiorre Delfico, "Ricerche su la sensibilità imitativa considerata come il principio fisico della sociabilità della specie e del civilizzamento dei popoli e delle nazioni", read in 1813 and published in *Atti della RAS*, 1819, 1:343-376.

[63] Mario Pagano, *Discorso sull'origine e natura della poesia*, in *Opere*, vol.2 (Lugano: 1836; orig. ed. 1791) pp.360-363.

[64] For his pedagogical ideas, see Melchiorre Delfico, "Memoria sulla perfettibillità organica considerata come il principio fisico dell'educazione, con alcune vedute sulla medesima", read in 1814 and published in *Atti della RAS*, 1819, 1:377-415; and Melchiorre Delfico, "Su la perfettibilità organica considerata come il principio dell'educazione", read in 1816 and published in *Atti della RAS*, 1819, 1:417-445. The last quotation is from Delfico, "Ricerche", *Atti della RAS*, p.367.

[65] See Lorenzo Balbi [Pasquale Borrelli], *Bibliografia di Pasquale Borrelli* (Koblenz [Naples]: 1840). For the identification of Borrelli as the author of this bibliography see Gentile, *Storia della filosofia italiana*, p.131.

[66] Pasquale Borrelli, *Principia zoognosiae medicinam physicae legibus scientifica methodo superstruentia* (Naples: 1803); translated in Italian in Naples, in 1808.

[67] Pasquale Borrelli, *Principi di zoaritmia scoverti da Pasquale Borrelli e preceduti da un ragionamento istorico su la moderna medicina matematica* (Naples: 1807).

[68] Pirro Lallebasque [Pasquale Borrelli], *Introduzione alla filosofia naturale del pensiero* (Lugano: 1824); and Pirro Lallebasque [Pasquale Borrelli], *Principi di genealogia del pensiero* (Lugano: 1825). His philosophical works were reprinted in Pasquale Borrelli, *Opere filosofiche*, 4 vols. (Lugano: 1839).

[69] We have mainly refereed to Francesco Bozzelli, *Essai sur les rapports primitifs qui liens ensemble la philosophie et la morale* (Paris: 1825).

Chapter Three

Mathematics and Revolution: Towards a Cultural History of Neapolitan Jacobinism (1790-1799)

3.1 Remarks on the "Spirit of Analysis"

By the term "analytic spirit" historians usually refer to a specific phenomenon which took place in the second half of the eighteenth century: the emergence and the success of a particular "way of thinking" or, according to the subtler definition of the *philosophes,* of a particular "savoir-faire". By the end of the century the "analytic art of thinking" was regarded by many as *the* paradigm of rational thinking in geometry, in the physical and empirical sciences, and even in the moral sciences. This is why a recent book entitled *The Spirit of Analysis* contains essays on the mathematical sciences as well as on natural philosophy, chemistry, medicine, education, scientific institutions and on other topics[1]. The analytic spirit penetrated indeed, in the eyes of its supporters, every branch of human knowledge. The need of a more generalized use of the new savoir-faire was justified by showing the impressive development of the mathematical sciences since the adoption of analysis as their unifying method. In fact, from Descartes onwards the refinement of the analytic method resulted in an unprecedented growth of mathematical knowledge and encouraged its successful application. The adoption of the new method had brought uniformity to the previously fragmented disciplines of geometry and algebra, clarity to their procedures, and practical efficacy to their application to empirical reality. Such a discrepancy between the development of the mathematical and physical sciences on the one side and the humanities and the moral sciences on the other, was certainly striking and somehow scandalous to men who had been mostly educated in Jesuit colleges, where a quite advanced mathematical education coexisted with the most dogmatic and rhetorical teaching of the "moral sciences".

As we have seen in the first chapter, one meaning of the term "analysis" was, in the eighteenth century, the method of solving mathematical problems (including those of "mixed mathematics") by means of reducing them to equations. The techniques employed in this process of analysis included algebra, differential calculus and integral calculus. The most varied problems of geometry or mechanics were translated into a linear sequence of symbols and then "reduced" to their simplest components via analysis. Each component could be considered in isolation, as an autonomous sub-problem, and this brought great economy of thought in the problem-solving process. But the term "analysis" also acquired another meaning: that of the proper scientific method. Indeed, the shift of interest from geometry to analysis in the mathematical sciences was accompanied by a more general philosophical elaboration according to which analysis should be accepted as a general way of thinking, and its use extended well beyond the boundaries of mathematics. In the writing of the *philosophes* the term "analysis" became almost synonymous with "rational thinking". So the abbé de Condillac (1714-1780) insisted that every science should be taught by analysis, this being the true method of discovery, and he considered the greatest error of the ancients their predilection for "synthesis". Voltaire argued that "the only way man can reason on the objects [of experience] is analysis"[2]. The paradigm of mathematical analysis lies behind much of the output in the natural sciences of the late eighteenth century[3].

In fact, claims about the possible extension of the analytic method beyond geometry are already present at least since the 1740s, following the continental elaboration of the work of Newton. It was at that stage that d'Alembert presented integral calculus as the privileged instrument of the savoir-faire of analysis. According to analysis, a mathematical or physical problem was solved by progressively reducing it to more simple operations, until certain operations are reached which are already mastered by the geometer. In his article on the *Encyclopédie*, d'Alembert explained to the common reader that analysis, as we already know, "est proprement la méthode de réssoundre les problémes mathématiques, en le réduisant à des équations". But he also added some more general considerations:

> elle fournit les exemples les plus parfaits de la manière dont on doit employer l'art du raisonnement, donne à l'esprit une merveilleuse promptitude pour découvrir des choses inconnues, au moyen d'un petit nombre de données; et en employant des signes abrégés et faciles pour exprimer les idées, elle present à l'entendement des choses qui, autrement, semblairent hors de sa sphére.

"Analysis" was an "art de raisonner"[4], an instrumental "savoir-faire", a way of thinking; it was not a corpus of specific knowledge, a set of principles, or a mathematical theory, as it was to be in the nineteenth century. The extreme generality of d'Alembert's formulation allowed the reader to draw the following conclusion: analysis is not necessarily linked to the field of mathematics.

Much of the heuristic power of analysis, the *philosophes* realized, lies in its use of a symbolic language, by which complex ideas are decomposed and the relations among simple ideas are presented in the most clear and immediate way. The necessity, for the advancement of knowledge, to employ this way of reasoning and its rational language was most prominent in the writing of a pupil of d'Alembert, namely Condorcet. Eric Brian has studied the attraction for mathematics showed by Condorcet since the 1770s, and the influence that "l'art de penser analytique" had on his philosophical and political thought[5]. In particular, Brian has pointed out the relation existing between Condorcet's promotion of the universal validity of analysis, and his belief in an ontological uniformity of reality. The metaphysical assumption of uniformity is indeed required, if we are going to decompose-recompose pieces of knowledge ("ideas" the *philosophes* would say) according to the analytic method, with the objective of discovering "new truths". Condorcet believed that the whole of mathematical reasoning consisted, in the end, in an enormous exercise of analysis; i.e. it consisted in a "decomposition of an ontological unity"[6]. But what does mathematics deal with, according to Condorcet?

> L'objet de l'analyse pure considérée dans sa plus grande étendue n'est autre chose que les diverses combinaisions d'une même idée et de l'idée la plus générale où les abstractions réitérées puissent conduire. Cette idée est celle de l'être en tant qu'il est un [...] Une science où tous les résultats ne sont que des propositions identiques, où tous les termes ne sont que des idées composées

d'une même idée, une telle science, dis-je, doit être à l'abri de toute équivoque, de toute erreur, de toute incertitude.[7]

Such a view of mathematics has a neo-positivistic flavor; but, in fact, this analogy is misleading. Far from having any axiomatic conception of mathematical theories, Condorcet made it clear that mathematical truths are "real", that they "appartiennent à la nature reélle", and that they are "discovered" at the end of the analytical investigation. This point, i.e. the nature of mathematical knowledge according to the "analytical orthodoxy" of the late eighteenth century, is particularly important for our present purposes. We should remember that in the eighteenth century the development of mathematics was essentially interwoven with that of the physical sciences. So that, on the one hand the more productive mathematicians of the period are driven in their refinement of mathematical techniques by the application of calculus to problems of mechanics; on the other hand, "les progrès de la *conceptualisation* physique sont inséparablement liés à ceux de l'analyse mathématique"[8], i.e. the new mathematical concepts provided a fruitful conceptual framework to make sense of aspects of physical reality (by making them measurable). This is the historical background against which d'Alembert presented, in the *Discours*, the sciences of nature as a continuum of abstractions imposed on reality by the human reason. Far from our contemporary distinction between "pure" and "applied" mathematics, eighteenth century mathematicians considered the problems of "mixed mathematics" (mechanics, hydrodynamics, etc.) as always, in principle, reducible to problems of pure mathematics, where "pure" had quite a different meaning from our own, and closer to that of "maximum abstraction from empirical reality". Indeed the reduction of physical problems was accomplished by means of a progressive elimination of unessential physical circumstances (i.e., abstracting from such physical conditions)[9]. Mathematical sciences could be thus presented as dealing with the results of a series of abstractions operated by human reason on natural reality. A conception which is closer to Galileo's *diffalcare gli impedimenti* than to the modern axiomatic approach.

The point is that, at the proper level of abstraction, *everything can become subject of a process of analysis*. And indeed Condorcet, following a suggestion of d'Alembert, remarked that the analytic procedure can be employed to discover the truth relatively to "un grand nombre de questions de métaphysique, de morale, de politique"[10]. Analysis has became a method to solve "les erreurs de l'humanité et les bassesses de ses contemporains"[11]. The practice of analysis, in these cases, consists in a de-composition of complex ideas in their own elementary parts; the knowledge of these constituents will then make possible the solution of problems involving such complex ideas. So, for example, if one has to judge on the advantages of certain financial operations, "il suffira presque toujours d'avoir analysé les idées pour en voir d'un seul coup d'oeil ou les avantages ou les inconvenientes". The same is true for every other field of investigation; chemistry for example, where "il y a un grand nombre de vérités que la decomposition des corps fait reconnaître". The analysis of complex ideas in their elementary constituents is presented by the followers of d'Alembert as the universal key to the understanding of reality, and as a necessary prerequisite for rational action in the empirical and moral sciences. Alexandre Koyré recognized indeed a crucial structural analogy between Condorcet's political and mathematical savoir-faire.

> [S]a méthode est tout abstraite: on pose un principe, on en détermine les conditions d'application et on en déduit les conséquences; ou inversement, on détermine le problème et on cherche la solution conforme aux principes. On pourrait dire que Condorcet a traité le problème de la constitution à donner à la France comme un problème d'intégration.[12]

What Koyré sees as analogous in the two procedures is precisely the common spirit of analysis. In fact, the reduction of an integral is intrinsically linked to the analytical savoir-faire[13]. But we could equally consider the analytical solutions of geometrical problems seen in the first part of this study: the "mental habit" at work there is the same.

We are now to consider another important aspect of the analytical savoir-faire, which concerns the relation between the procedure of reduction by analysis and the procedure of classifying objects by means of so-called "analytical tables". "To analyze a problem", as we have seen, means to present systematically all the possible cases that can be originated by the conditions of the problem itself. Analogously, an analytical demonstration must consider every possible case falling under the theorem. In the words of Gilles Granger: "constamment, il [Condorcet] appuie sa démonstration sur une classification des cases jugés possibles". In this perspective, which is present not only in Condorcet's writings but in every contribution offered at the French Academy in the section "analytical memoirs", a satisfactory demonstration is accomplished when all the possible cases have been taken into consideration. Such demonstrations are founded not only on the formal coherence of their passages (as in the modern conception of proof), but also in the "systematic coherence" of the set of the possible cases which has been taken into consideration. This means that, in proving a theorem or in solving a problem, the analyst is bringing to light something like a *tableau*, i.e. a subjacent classificatory table. Or, to put it differently, that the composition of classificatory tables and the solution of problems by means of analysis are founded on one and the same savoir-faire. To grasp this essential connection between analytical classifications and method of analysis is crucial, if one wants to follow the historical enlargement of the empire of analysis well beyond the boundaries of mathematics. Condorcet and his followers assumed that where it is possible to analytically classify, there it is possible to reason analytically. This means that the belief in human knowledge being wholly analyzable, and of analysis being the most rational way of thinking, cannot be properly understood without referring to the structural re-ordering of knowledge performed by the *philosophes*.

Before presenting this new "structure of knowledge", a question must be addressed which arises from our previous exposition. In the first part we have described the problem-solving methods of the two Neapolitan schools of geometry. By "analysis" of a problem they *both* meant the reduction of that problem to some task that was already familiar to the geometer, with a movement from the unknown to the known. The process of reduction as such was not peculiar of the analytic school; geometrical analysis consists itself in a reduction of complex problems (i.e. constructions) to more elementary problems that we have already solved (i.e. constructions that we have already performed). This point has not been stressed enough by historians like Brian, who focus on the innovative character of the "analytic spirit". So, what is *properly* innovative in the analytic method? As I have already remarked, the crucial difference among the two methods is that in the synthetic one the reduction is operated from complex geometrical constructions to more elementary geometrical constructions; whereas in the analytic one a general method of reduction (analytical savoir-faire), which operates through a universal language (algebra), is imported into geometry "from outside". Geometrical analysis is a process which begins and ends up in the science of geometry; its procedures and its final justification are to be found in geometry. Algebraic analysis, as it was used by Lagrangian analytics, is in need of some external foundation; geometry being only one of its many possible fields of application.

We can now recapitulate and re-elaborate the previous arguments, in the light of the results of our study of the geometrical controversy in Naples. What we take as essential in the "analytic spirit" is not just the breaking down of an aggregate into its constitutive and autonomous parts; traces of the very same process are indeed evident in the classical synthetic approach to geometrical problems. What is new is that analytic geometers employed a method which was not specific to geometry, being rather an expression of a general savoir-faire, a mental habit whose use is *not restricted* to the sublime world of pure geometry. The analytic habit was indeed claimed to be the "natural way of reasoning", once human reason is freed from the conceptual darkness of the scholastic tradition. Algebraic analysis works whatever the problem is, whatever the branch of mathematics is and, as we have seen in this section, whatever the branch of knowledge is. Rather than just a method to reduce the complex to the simple through analysis and classificatory tables, we are dealing with a method to reduce the complex to the simple through a *universal* analysis on the basis of a *new* classificatory table. And indeed, only a new classificatory table of knowledge could allow analysis to be truly universal. Only in the framework of a new hierarchical disposition of the different forms of knowledge would it be possible *to think* of analysis as a universal method, and not a mere specific technique for geometrical problem-solving. This is why, to make sense of the success of the analytical savoir-faire, we have to look at the contemporary re-ordering of knowledge accomplished by the *encyclopédistes*.

The whole enterprise of the *Encyclopédie* is founded on a new and very influential classification of human knowledge, which is presented in the *Discours preliminaire* by d'Alembert. This new table is indeed a *summa* of the epistemological revolution accomplished by the first generation of *philosophes*, and the manifesto of the "analytical orthodoxy". Let us follow its principal divisions. First of all, we see that human knowledge is presented as a whole, and its unifying factor is the nature of human understanding. This unity is then divided in three main parts, depending on the three intellectual faculties: memory, reason, and imagination. A further division is made in each branch according to the three objects of knowledge: God, man, and nature. Then different criteria of division are adopted, depending on each specific case. A few remarks can be made about this "system". Firstly, "analysis" is not classified under "mathematics", but instead under "art of thinking". Secondly, the criterion used to classify natural and mathematical sciences is their degree of generality; they are ordered as if they were the result of progressive abstractions imposed upon natural reality by the human understanding. The most crucial innovation contained in the encyclopedic table consists in an epistemological shift, whose effects are not immediately evident when reading the articles. It is a matter of fact that the articles contained a great amount of useful information, and that this was one important reason for the editorial success of the enterprise[14]. Yet the volumes of the *Encyclopédie* were considered "dangerous" by the political and ecclesiastic authorities. Collaborators were under police control from 1748, the Royal Privilege was withdrawn in 1759 (seven volumes had been published up to that moment), and in this very year the volumes entered the *Index Liber Prohibitorum* of the Catholic Church. Why? The reason can be clarified with an example. Look up the article "Eucharistie", and you will find an orthodox presentation of the sacrament of the Holy Communion; but also stressed is its intrinsically irrational nature: "il s'agit d'un mystere. [...] la chose se réduit à une pure question de fait, aisée à décider par le monumentes que nous venons d'indiquer: car si l'on veut rendre la raison seule arbitre de cette dispute nous convenons qu'elle est un abysme de difficultés"[15]. Things get even worse if one pays attention to the subtle messages embedded in cross references. Under the heading "Anthropophagy" one reads ""voyez Eucharistie, Communion"[16]. The average eighteenth century reader would experience, at this point something like a sudden frame-switch: something would seem to him clearly out of place. The mystery of the Eucharist, the everyday miracle which is the very center of the Catholic liturgy has been neither de-mystified nor denied in plain words but, more subtly, it has been removed from its original conceptual space and placed together with a phenomenon such as anthropophagy: a monstrosity, an aberration, a deeply irrational practice. The underlying change can be identified as an epistemological shift, consisting in the re-organization of the whole conceptual space according to new grouping principles; which can also be seen as the introduction of a new structure of knowledge. According to this, religion is at the margins of human knowledge, it cannot really fit the rational divisions which regulate the other fields of human understanding and human action. If we now look at Chambers's tree of knowledge, which appeared in a French translation of 1741 and was taken as a starting point by the *encyclopédistes*, we can see that here "Religion" is classified under "Rational Knowledge", where we can find the "intrinsic characters of sensible things", such as: Powers (Physics, Natural Philosophy), Abstracts (Metaphysics), Quantities (Pure Mathematics – by the way, "analysis" is down this branch), "Relations to our happiness" (that is, Religion). This means that Religion was, in fact, the Queen of the Sciences. Francis Bacon's tree was the other important reference, and indeed it presents an evident morphological analogy with the encyclopedic tree. Still, in Bacon's system Natural Theology is fully legitimated as a branch of philosophy, together with Natural Philosophy and Human Philosophy. The crucial step taken by the *encyclopédistes* was the introduction of elements from Locke, particularly the epistemological tenet according to which all knowledge, which derives from the three faculties, is based on sensations. If we are going to accept this sensationalistic position, it will follow that religion cannot be considered genuine knowledge; it has lost its place in the space of knowledge. Now, let us go back to the encyclopedic system, and let us look where Religion is placed. Natural Theology and Revealed Theology are in an apparently reassuring position: on top of the system, as in Bacon. But they are out of the kind of knowledge deriving from sensations and, what is most revealing, they are classified together with "Knowledge of Good and Evil Spirits", "Divination", and "Black Magic". Religious knowledge shares the same epistemological status as Black Magic, and its practices have the same rational foundation as the practice of Anthropophagy. This vehement anti-religious spirit was not obvious to the standard reader of the technical articles of the *Encyclopédie*, but the Catholic censor could not escape the ambiguity of the internal references or the fact that, regularly, religious conclusions are supported by faulty logical arguments. And in fact he didn't. The censorial action was not directed against any specific heretical statement, but rather against the epistemological shift that pushed religion and its scholastic conceptual apparatus out of the region of legitimate knowledge. To sum up, in the encyclopedic system of classification, religion is relegated to an ambiguous limbo, it is out of place, with all the risk and the emotional tensions involved by this being not-classifiable knowledge[17]. Yet the epistemological shift was not neat and explicit; in many ways the tree of the *Encyclopédie* is a compromise between previous systems of knowledge and the new one. To Neapolitan Jacobins the encyclopedic tree had to be itself overcome, in the direction of a more radically sensationalistic epistemology, according to which traditional metaphysics and religion would simply disappear from the tree of knowledge.

3.2 The Spirit of Analysis in Naples

The introduction of specific textbooks of integral and differential calculus in the curricula of Neapolitan institutions of higher education was not straightforward, and it was relatively late when compared with the situation in Northern Italian states[18]. Infinitesimal methods had been used to treat specific questions of mechanics and physics at least since the publication of the treatises of the brothers di Martino in the 1720s and 1730s. Still, there was no space devoted to differential calculus there, apart from Nicola's treatise which, anyway, remained in manuscript. His successor at the university chair, Giuseppe Marzucco (1713-1800), employed some differential and integral calculus in his 1767 textbook on the squaring of curves[19]. In the 1750s calculus was privately taught in Naples by the Tuscan Girolamo Saladini (1731-1813), who was to become professor of Analysis at the University of Bologna in 1761. In 1775 Saladini, who had remained in touch with the Neapolitan scientific community (he was to enter the renewed RAS in 1779), published in Bologna a textbook of analysis in two volumes (algebra and calculus) specifically designed for the cadets of a Neapolitan military college, with a dedication to King Ferdinando IV. The second volume was to be re-edited in 1790 as a textbook of calculus by a professor of the Neapolitan Military Academy[20]. Great space had been given to algebra in the many volumes of the courses of mathematics written by Vito Caravelli for the Military Academy (1759-1770; 1770-72), which included a wide treatment of the sciences of mechanics and artillery. And it was Caravelli who, with the contribution of Vincenzo Porto[21], published the first textbook of differential and integral calculus ever published in Naples, in 1786[22].

A reason for the late contribution of Neapolitan authors to the publication of textbooks of calculus was that the few active mathematicians in Naples had been charged with the organization and direction of the military academies. Their energies were absorbed by the publication of massive elementary courses in geometry, algebra, "practical geometry", the science of artillery and nautical science. Those in chairs at the RUN were secondary figures, such as Marzucco, who showed little inclination to any sort of renewal of mathematical teaching and research. But the situation was rapidly changing in the 1780s. We already referred to signs of a new interest in analysis that arose among the reformers. By 1790 a group of mathematical practitioners had enthusiastically embraced the "analytical orthodoxy" *à la* Condorcet. That is to say, they adopted analysis as the fundamental and more general way of scientific reasoning, from the mathematical to the moral sciences. The school of Genovesi had already taken inspiration from the encyclopedic program. The idea of a science which was not "pure", contemplative, but "modern", i.e. linked to the real needs of the population, had been spread by the writings of the reformers and by their translations of the French *philosophes* since the mid-century. Still, their programs and analysis are inserted in a reformist perspective; furthermore, there is no particular interest in the quantitative analysis of the social world. At the turn of the 1790s, however we find exactly this emphasis on the "calculability" of social reality, combined with a new political radicalism which is already in the cultural and political area of Jacobinism.

If the personal development of a few members of this heterogeneous group have been studied by historians, still the phenomenon of Neapolitan Jacobinism is in need of a general assessment. More importantly for our present purpose, the relation of Neapolitan Jacobinism with scientific thought has never been addressed. The lack of research in this direction becomes evident when we look at the crucial figure of Carlo Lauberg (1753-1834). Lauberg was a Jacobin leader as well as a scientist and a teacher of mathematics, but his scientific and pedagogical activity has been considered irrelevant in making sense of the political and social features of Neapolitan Jacobinism. In the following, the two parts of Lauberg's artificially split biography will be presented instead as crucially related.

3.3 Carlo Lauberg and the 1794 "Jacobin Conspiracy"

Let us begin from Lauberg's political activity. To follow Lauberg in the last decade of the eighteenth century means to reconstruct the nature and the operations of

Neapolitan Jacobinism itself, of which Lauberg was the undisputed leader —as well as the main theorist. Most of what we know about the conspiratorial activity of Lauberg in the early 1790s is contained in the surviving proceedings of the political trials against the Jacobins which began in 1794; this is indeed the source for the following reconstruction. A crucial crossroads within his complex activity was provided by the private studio of chemistry and mathematics that he had opened in May 1792 together with Annibale Giordano (1771-1836) In piazza Santa Caterina[23]. Lauberg and Giordano had been teaching privately at university level since around 1790, at Lauberg's house in Vico dei Giganti, a dark, narrow street in the heart of the ancient town, a few hundred meters from the Cathedral. This was known as a place were students and colleagues met regularly to discuss modern chemistry and mathematics, i.e. the recent works of Lavoisier and Lagrange. At that time Lauberg was a temporary lecturer of chemistry at the Military Academy, and he was attempting to enter university as a professor. Giordano, in spite of his age, was already a well-known mathematician. He had been trained at the school of Nicola Fergola and in 1789 he had been awarded a chair of mathematics at the Military Academy. In 1786, aged fifteen, Giordano had presented to the members of the RAS a very elegant and original synthetic solution for the "problem of Cramer". This solution was published in the acts of the *Società Italiana delle Scienze* by Antonio Maria Lorgna (the only mathematical work from Naples published in this prestigious Italian journal in a long time[24]), and it was to be cited by Michel Chasles and Lazare Carnot in their historical works.

Since its foundation in the Spring of 1792 Lauberg's "academy" was an important center of the scientific life of the town. Lessons were given twice a week to young men "of distinct condition", who were taught mathematics, chemistry, but also "democratic doctrines"[25]. Indeed, at the end of the lectures, Lauberg used to discuss with some of his students the works of Neapolitan reformism, of the French *philosophes* and, most interesting to the inquisitor, he spoke about "politics, the facts of France, and about the success of talented individuals living under popular governments"[26]. Most of the young students were from well-off families of the province, and they had moved to Naples to study law, medicine or to enter the professions. Among them were Emanuele de Deo (1772-1794) , Ignazio Ciaia (1766-1799), and Matteo Galdi (1765-1821). But the academy attracted people from various backgrounds: from young students fleeing university lectures to well-known professors and intellectuals, such as Mario Pagano, from professionals (mainly lawyers and physicians) to specialized artisans (such as cabinet-makers and clock-makers). A few young members of the most ancient aristocracy of the town were also attending the courses, as did some clergymen and indeed almost "everyone who was to be involved in the political trials of the following years"[27]. In fact, the meetings of the "academy" assumed soon a conspiratorial character. The previous masonic experience of many participants (including Lauberg and Giordano) was exploited to establish a new kind of secret society.

By the late 1780s the institution of freemasonry was in deep crisis, following internal fractures, the failure of the reform movement to which it was strictly linked, and the new anti-Masonic moves of the government, whose suspicions were growing about the anti-despotic plans of freemasons. Yet, the model of association offered by the lodge was still to play an important role, while disappearing from the scene. Around 1790, this model underwent a transformation which turned the enlightened lodges into cells inspired to the Jacobin clubs. An intermediate model of association was the system of clubs introduced in 1789 in the town of Tropea, Calabria, by abbé Antonio Jerocades, a former student of Genovesi and author of some anti-curial pamphlets., and a frequenter of the academy of Santa Caterina. Jerocades' clubs were a sort of terrorist-conspiratorial cells, directly depending on the secret society *Sans Compromission*, which was active in Marseille[28]. In 1789 Jerocades published a book which enjoyed a certain success, where in the form of a poetical composition, the author exalted freemason values[29]. In 1790 the head of Neapolitan police reported to the government about the existence of unusual Masonic lodges in Calabria, depending directly on Marseille. He reported that in these lodges "the French events are not ignored", that they "are discussed, and the circumstances are well known"[30]. Between 1791 and 1792 Jerocades was in Naples, where he founded a few lodge-clubs of the new kind. One was presided by Domenico Bisceglie (1756-1799); "here gazettes and excerpts from Condorcet's *Chronical* [*Chronique de Paris*, 1791-93] were read; religion was freely discussed; monarchs were criticized [...]; the French revolt was defined as an attack against tyranny"[31]. The theoretical framework of these early conspirators was indeed deeply influenced by Condorcet's writings. They planned a radical opposition to the present authorities; they justified violent rebellion appealing to the "rights of reason" and to the cause of "civil progress"; they stated as their main objectives "liberty" and "equality", which can be achieved only in the context of a republican state; they attacked official religions, because they support fanaticism and superstition, and are instruments in the hands of political power. Annibale Giordano was among the frequenters of Bisceglia's club, together with Francesco Saverio Salfi (we met him briefly as a reformer) and Ignazio Ciaia, employed at the ministry of Ecclesiastical affairs. Salfi and Ciaia set up in the town a network of *conversazioni* (conversations), small groups of masons who met in private houses or in artisan workshops. Giordano and Lauberg were both frequenters of the conversation at Salfi's house, together with abbé Giuseppe Cestari (1751-1799). Salfi and Cestari also made propaganda among the workers of the harbor, and at the opera theater, where elements of the ancient aristocracy had shown interest in an anti-monarchic plot. A group of university students from the province met regularly in a book-shop in via Toledo, under the supervision of Raimondo Grimaldi (1762-1852) a Benedictine monk who ran a school of algebra and was "very close to Giordano and Lauberg"[32]. Indeed those frequenting the Toledo book-shop could be invited to join the meetings at Lauberg's place in Vico dei Giganti, where French gazettes were read twice a week, or at the academy of Santa Caterina. Eventually, the most reliable elements were affiliated to the secret society. Troiano Odazi (1741-1794), one of the most authoritative economists of late reformism, was another important member of these early conspiratorial groups. Since 1781 he had been teaching from the chair of Economy that had once been Genovesi's. In August 1792 the French ambassador Louis-Armand de Mackau settled in Naples. He himself protected a Marseilleise club guided by a professor of French of the Military Academy. Lauberg frequented this club and met regularly with the ambassador, who provided him with recent Parisian press.

Whether the label of "Jacobinism" is indeed suitable to describe the Neapolitan movement is controversial[33]. Venturi, for instance, maintained that it is improper to employ the term after the dispersion of the Jacobin movement in France; he also underlined the original features of the Neapolitan conspirators, who referred chiefly to the experience of Neapolitan reformism. In the present study the term "Neapolitan Jacobinism" is employed as a useful label for what was in fact a

A Jacobin *conversazione* in 1794 (at the centre, Saverio Salfi) republican, democratic and anti-Catholic movement that planned violent insurrection against the government and the monarchy. The program of the movement was inspired by French Jacobinism and opposed the policy of the French Directoire, represented in Naples by ambassador Mackau, who attempted a late reconciliation with the Bourbon monarchy. Certainly the links between Neapolitan Jacobinism and Neapolitan reformism are many and important. It is a fact that among the Jacobins of the 1790s one finds many of the reformers of the 1780s. I have also remarked that the specific interests represented by reformist projects and the specific interests represented by the Jacobin project were largely overlapping. To adopt a different term ("Jacobinism") is nonetheless useful in order to capture the radicalism of the goals and means proper to the new political project.

Neapolitan Jacobins saw an essential link between political action and "moral action", so that their fight was against despotism as well as ignorance and superstition[34]. The movement was composed of academics, military officers (particularly from the artillery and from the navy), students, professionals, craftsmen and small traders of the town. In the provinces, it attracted mostly bourgeois landowners and the minor aristocracy. Neapolitan Jacobinism has been rightly described as defending the interests of "the small minority of the enlightened bourgeoisie that opposed the old regime"[35]. Nevertheless, an aristocratic element was present in the movement, particularly in Naples, as remarked by the Neapolitan ambassador in Rome in 1792: "the majority of Neapolitan Lords [*Signori*] and lawyers were all [...] democratic and they look forward to seeing the French in Naples"[36]. The reason is probably to be found in the strong anti-monarchist feelings of the ancient aristocracy of the capital, whose political and juridical status was seriously threatened by the recent attempts of the Bourbons to pursue an absolutist and anti-feudal policy. Among the founders of the academy of Lauberg and Giordano was indeed Ettore Carafa Count of Ruvo (1767-1799), from one of the most eminent families of Naples[37]. It is precisely because it was linked to very specific interests that the Jacobin movement, in the end, was to fail to earn the crucial support of the peasantry and of the popular strata of the town[38].

Little more was needed to transform these variously related conspiratorial lodges and clubs *à la marseillaise* into a well organized anti-monarchist plot. A noteworthy episode in December 1792 acted as a catalytic factor. The Neapolitan government, fiercely anti-French since the very beginning of the revolution, had recently plotted to prevent France from being diplomatically represented in the Ottoman Empire. As a response the French government sent a naval force to the Gulf of Naples threatening to bomb the town. Admiral Louis de La Touche-Tréville was in command. Diplomatic meetings followed, with La Touche being received by King Ferdinando IV. But this is not the interesting part of the story. The point is that the French Admiral and his officers sojourned in town between December 1792 and January 1793[39]. In this period La Touche repeatedly met Jacobin leaders, particularly Lauberg and Giordano. The Admiral also attended to some experiments performed by Lauberg (whom he called "le citoyen chimiste") at the academy. During one of his visits to the academy, La Touche made a speech inviting the audience "to emulate the French nation"[40]. Giuseppe Cestari, one of the frequenters of Bisceglia's club, offered a dinner where local Jacobins met the French officers; then, in January, the admiral reciprocated the courtesy on board his flagship *Languedoc*. Among those invited were Odazi, Jerocades, Salfi, the mathematician Vincenzo De Filippis, Ascanio Orsi, and some artillery officers. On this occasion the project of a general reform of Neapolitan lodges was discussed and approved by La Touche, who also promised military support in case of an armed insurrection. Shortly after the fleet left the Gulf, the well informed head of Neapolitan police, Luigi de' Medici, cautiously intervened. Without too much clamor, the ecclesiastics Jerocades and Cestari were segregated in monasteries far from the town. At this point Lauberg took charge of the whole movement: he decided to re-shape it in the form of an organic society, and to prepare a concrete program of short-term action. His propagandizing was intense, and the movement increased his favour among groups of merchants and financiers who saw their interests threatened by the new anti-French policy of the government (France was at that time the main importer of Neapolitan products). In May 1793 Lauberg was at the head of the *Society of the Friends of Liberty and Equality*, and became the real "political author of the conspiracy"[41]. New members were enrolled and a translation of the radical 1793 French Constitution was completed by Lauberg and Grimaldi, published in two thousand copies, and clandestinely distributed. In July 1793 rumors ran in Naples about a military alliance with Great Britain. Immediate action was required. In the

Summer 1793 Lauberg met his "most surely democratic" friends in Posillipo to plan the abolition of the surviving traditional lodges (mostly aristocratic ones) and their definitive absorption in the network of Jacobin clubs[42]. Among them were some lawyers, the mathematicians Giordano, Grimaldi, and Carlo Antonio del Giorno – professor of algebra at the University of Catania– and the artillery officer Ferdinando Visconti. Lauberg pointed out the objectives of the movement: a republican government, the end of the feudal abuses, liberty and equality for every citizen and the rejection of "every religion, as extraneous to the natural order and invented by sovereigns and supreme authorities to guarantee their stability". The structure of the new association, the *Neapolitan Patriotic Society*, was approved at the same meeting. It was an interesting variation on the traditional Masonic lodge. The *elementary clubs* were small autonomous units with no more than eleven members; each one having a president and a secretary. No hierarchical differences existed among functionaries, as "in these clubs they hold to the equality of individuals"[43]. Elementary clubs were "the elementary parts of the whole body [the secret society]". Each elementary club elected a deputy; all deputies met in a "deputy club", again with no more than eleven members. Each deputy club elected a representative to be sent periodically to the "central club". Thanks to the deputies, "the harmonic chain" among different levels was preserved. Lauberg was elected "central point" of the society. The central club had executive and legislative power. Its members were elected through a complex procedure, and they could be members of any level. Clearly enough the organization was shaped by practical considerations, such as that of rendering the identification of members extremely difficult, but it was also being employed as a social laboratory where new forms of social life were tried. Its "democratic" and "egalitarian" nature is evident. Note the fragmentation of the organization in a set of "elementary" units; each one contains members all enjoying the same rights and duties, differences among members being only in function.

By Autumn 1793 Lauberg, President of the Patriotic Society completed his "reform" of freemasonry and was in the middle of his activity of "democratization of souls"[44]. The primary objective of the new association was the forging of a revolutionary plot. This included the occupation of the Royal Palace and of the fortresses, the physical elimination of the monarchs, and the constitution of a provisional government. The reactionary author Augustine Barruel, evidently horrified, described the details of the Neapolitan plot in his memoirs[45]. In September 1793 the ambassador Mackau left Naples, because of the state of war between France and Naples. Many more entered the Society, confident in a French expedition which would support the newborn republic. In those very days, at the meetings held at the club hosted in the workshop of the clock-maker Andrea Vitaliano, questions such as the existence of God, the immortality of the soul, and the political conditions of the country were discussed. Vitaliano and his friends maintained that "the people have the faculty of accepting or rejecting kings"[46]. Similar points were touched at the meetings hosted by Marquis Giovanni Letizia in his palace at Capodichino, a few miles out of town. Letizia was one of the links between the Society and aristocratic freemasons, who "were looking with sympathy at Republican France". The number of elementary clubs rose between December 1793 and January 1794. There were clubs in the army, in the provinces, and also in the *Ospedale degli Incurabili*, a major Neapolitan hospital and a center of medical research. The students of Lauberg's academy were active founders of clubs all over the kingdom, exploiting the diffused hostility against a government which had been unable to prevent the scarcity of food due to the bad crops of Summer 1793. But it is precisely in the provinces that the Jacobinic movement was to clearly show its limits. The "new men" of the rural areas were fighting their own battle to strip the barons of their feudal rights and to control local administrations, real keys of the economic development. Little consideration was given to the growing complaints of the peasantry. It is indicative that among the peasants the term "Jacobins" meant wealthy landowners and professionals, that is, the new oppressors. Peasants had no part in the struggle between bourgeois landowners and feudal barons. Their conditions were indeed worsening, as the common lands were being enclosed by barons and new landowners, and their communal rights abolished without any form of compensation. Hostility was growing against the abuses of the "gentlemen" (*galantuomini*), as peasants called the new landowners.

In December 1793 the student Emanuele de Deo, from Lauberg's academy, traveled to his native province of Apulia. He brought copies of Lauberg's edition of the French constitution. He met members of the local authorities, informed them about a near insurrection, claimed "that the people have the right to dethrone the king and to execute him"[47]. His activity did not pass unnoticed, though. Following de Deo's mission in Apulia, a spy infiltrated Lauberg's academy. He reported on the meetings at Lauberg's house, and about the dangerous religious and political opinions of Giordano, Grimaldi and Ciaia. House searches were carried out following this report. Nothing compromising was found in Naples; at Lauberg's place officers seized and confiscated "pages covered in mysterious algebraic signs". But copies of the French Constitution were found at de Deo's place, and he was immediately arrested. The Society decided that Lauberg had better flee the country. This happened in January 1794, with the economic support of Marquis Letizia. Lacking its charismatic leader, the Society soon split into two distinct revolutionary circles, one supporting immediate action, the other suggesting a more cautious preparation of the insurrection. In March 1794 an informer revealed further names and the circumstances of the plot. By now the police had an almost complete picture of it. Searches and arrests followed. A special tribunal was established (*giunta di stato*) to judge the hundreds of people involved in the Jacobin conspiracy (*congiura de'Giacobini*). The accusation was very grave ("conspiracy against Religion, Monarchy and State"), thus trials were conducted with the exceptional procedure *ad modum belli* ("as in a war"), which meant judgment was reached and sentence passed in the space of a few hours, and without granting basic rights to the accused. Mario Pagano denounced the improper use of the special procedure, and organized a plan of defense for de Deo and his comrades. But he himself was arrested in 1795, because of his links with Lauberg's academy. Emanuele de Deo and the clock-maker Vitaliano were hanged in Largo Castello in October 1794, the town immersed in an atmosphere of extreme tension. Bourbon soldiers opened fire on the mob without any clear reason, and a few people remained on the ground, shot dead. Meanwhile, hundreds of others were given various sentences. In 1798 arrests and trials were still going on, and by then it was clear that the dimensions of the conspiracy were indeed remarkable, involving members of the aristocracy and high functionaries of the government. Panic was indeed spreading at the Bourbon court, where the 1793 execution of the French sovereigns had already had a remarkable effect[48]. Annibale Giordano was sentenced to life imprisonment in the fortress of Aquila. Ettore Carafa Count of Ruvo was arrested in 1795; in the same year —to the astonishment of most— Luigi De' Medici, head of the police, was also arrested, suspected of having protected Giordano and the academy from an early investigation in Summer 1792. The artillery officer Ferdinando Visconti (1772-1845), who had taken part to the most crucial events of the conspiracy, was accused of being a member of the Deputy Club, and of keeping Giordano informed about the activity of the clubs established inside the Body of Artillery; he was sentenced to ten years in the fortress.

3.4 Lauberg's Political Thought

We have already found, in the proceedings of the trials, traces of Jacobin political thought, mainly arguments in favor of republicanism and of democracy (frequent claims that sovereignty is of the people). So, we read that when Giordano's house was searched, the following documents were found: "an handwritten excerpt from Locke, treating the nature of government and its real origin, extension and goals, and the argument that happiness is to be found in equality, because men are made of one and the same nature"; the *Political Essays* of Mario Pagano; a manuscript where it is argued that "whatever a nation on the Earth desires, it has the right to do so" [49]. Giordano was also charged with having repeatedly declared his "lack of belief in matters of religion" at the meetings held in the house of Raffaele Netti (1776-1863), teacher of physics[50].

For a clearer presentation of these tenets of Neapolitan Jacobinism we must move from the proceedings of the trials to the more coherent political speeches and writings of Lauberg himself. Dominant themes were: republicanism, democracy, and religious freedom (religious beliefs must not be a matter of legislation). The two values on which the whole Jacobin project was grounded were "freedom" and "equality", which were to become the motto of the Neapolitan Republic (Fig.X). Freedom means "the freedom of doing whatever is not forbidden by the law"; and "equality" means not some sort of "absolute" (read: economic) equality which would be "unnatural", but rather —in the best reformist spirit— that every citizen must enjoy equal political and juridical rights. Consequently Lauberg planned the destruction of the monarchical institution; the immediate abolition of the feudal-communal system, based on political and juridical inequalities; and the confiscation of the goods of the Church. The attack on the Church was crucial to the anti-feudal plan of the Jacobins. Already in the proceedings one can find reports of various acts of scorn for religious institutions: Lauberg's students scoffing at the images of the saints[51]; the existence of God and the immortality of the soul questioned in Vitaliano's workshop[52]; Lauberg claiming that "hell is a tale to keep the people in control; there is neither Hell nor Heaven, as death is the end of everything"[53]. The recognition of a crucial ideological function for institutional religion caused the Jacobins to transform the traditional anti-curialism of the reformers into a full-blooded attack against the Catholic Church. The two-fold attack against Church and feudal system emerges in almost every page of Lauberg's political articles written after 1794, as indeed in those of the other Neapolitan Jacobins who had fled the country in that year.

In 1794 most of the Neapolitan Jacobins were in France. In 1796 they entered the Northern Italian towns, following Napoleon's army. Milan became the main center for their activity of propaganda. Between 1796 and 1799, the so-called "triennio giacobino", Neapolitan Jacobins were to act as public speakers, journalists and political organizers in Northern Italy[54]. As a matter of fact, their activity was not welcomed by French authorities, worried about democratic radicalism and Italian patriotism which their speeches referred to repeatedly. In 1797, Napoleon himself referred to them as those "qui ont toujours apporté en Italie le trouble et l'anarchie"[55]. Lauberg had entered the French army as officer pharmacist ("pharmacien de première classe") in September 1793[56]. He settled in Milan with his former students Matteo Galdi and Flaminio Massa. They organized "patriotic theaters", societies "of public education", celebrations to make the planting of the "trees of freedom", and they founded and directed periodicals such as *Il Termometro Politico, Il Giornale dei Patrioti d'Italia, Il Monitore Italiano*. Their immediate goal was to win the support of the educated classes in the newly occupied towns by presenting the advantages of a republican form of government, and of a philo-French policy. As a town fell into the hands of the French army, these political activists scrupulously performed their work of "democratization". These patriot-Jacobins also referred to their mission as being concerned with the "regeneration" of the Italian towns, a term which clearly resonates with the masonic doctrine of social harmony that we have found in Filangieri. Lauberg himself was active in the "regeneration" of Bergamo, Brescia, and Verona. In Venice he was president of the

Society for Education, where he presented the "moral and political principles to be taught to the people"[57]. Among his political works is an essay about the best form of government for Italy (1796), where Lauberg defended the form of a democratic republic. He also maintained that the republic must be formed by the reunion of "individuals" in a single "body", and he rejected any form of federalism as extremely dangerous to the well being of the state. It is not difficult to see the criticism of the plethora of intermediate bodies existing in the Neapolitan feudal-communal system behind such remarks. In Lauberg's view, the old enemies of the Italian people have always been "superstition, aristocracy and federalism". This was why in the future republic the institutions of hereditary aristocracy, majorat and fidei-commissum —as any other source of "particularism" in jurisdiction, customs, and currency— would be abolished.

In a piece in *Il Monitore Italiano*, Lauberg celebrated —*à la* Condorcet— "the progress of the human spirit in Italy"[58]. Lauberg moved from the remark that the Italian Renaissance lacked "the theories of quantity", those which allow us "to measure, to evaluate, to calculate and to know with precision the natural beings, their qualities and attributes". Coming to the eighteenth century, Lauberg praised the work of scientists such as Gaetana Agnesi, Morgagni, Vallisneri and Redi, and of philosophers such as Vico, whom he saw as a crucial source of Condorcet's conception of progress in history. The advancements in mathematics, physics, chemistry, and botany had been the basis for advancements in the "economical sciences", agriculture and in the "mechanical sciences". But, said Lauberg, in spite of the efforts of these valuable thinkers, the Italian states could not enjoy the fruits of cultural and social progress, mainly because of their erroneous system of laws (and here Lauberg cited Filangieri's *Science of Legislation*). In particular, the "feudal system prevented the Southern regions from achieving that progress that would have been natural"[59]. Because of an irrational social system, "trade did not grow, and mathematicians did not have the opportunity to emulate England in naval science". The French revolution gave Italy the occasion to free itself from such a social system, and to participate in the "regeneration of humanity"[60]. In this most important moment the intellectual class had to take command and lead the nation: "the mathematician abandoned abstruse calculations to become a legislator; the physicist moved from his cabinet to the committee, the chemist forgot the laboratory to become a statesman , the lawyer, the physician, the tradesman, the shopkeeper, the peasant, even the priest, they all did their own part to be useful to the cause of humanity". In the end, the truth "will enlighten the people and will guide the government, [...] will give back to Italy its freedom, its virtues and its ancient grandeur".

In an economic article in the same newspaper, Lauberg dealt with the question of prices[61]. He maintained that high prices are indeed the sign of a healthy economy: "the high price of things revives national prosperity", he wrote, because it pushes both individuals and governments to entrepreneurial action. Land reclamation, ploughing, and other forms of productive investments are indeed natural consequences of high prices. High prices cause "movement", Lauberg synthesized. And everyone benefits from such a movement: landowners as well as peasants and artisans. Lauberg wanted freedom of action for entrepreneurial activity: the legislator should not be "wanting to regulate everything". And the usual policy of artificially lowering food prices to feed urban masses is in the end deleterious to the healthy functioning of the economy, because it damages agricultural producers. Lauberg concluded with a plea for a free-trade policy: "the Pope used to prohibit exports —you must knock down all those infernal barriers". From our previous remarks about the functioning of the feudal communal system in the Kingdom of Naples at the end of the century, it is quite clear that similar economic ideas were radicalizing the position of the 1780s reformers, and were in fact at odds with the real conditions of Southern agriculture and trade.

An interesting and distinguishing feature of Lauberg's political speeches is the reference to scientific knowledge as a source of legitimization for political action. He did not simply exalt the progress of the sciences under a republican government; he always tried to found his political reasoning on a precise scientific conception of the world. In a piece in the *Journal of the Italian Patriots*, Lauberg celebrated the conquest of Mantua as an important step in the political and social progress of Italy[62]. This progress cannot be stopped by any historical force. Its "necessary" character depends on its being grounded in the very nature of man. Civil progress is the necessary path of mankind once it has been freed from ignorance and oppression. Lauberg made an analogy: "as the sensations in the small sphere of our individual existence shape our heart and our understanding, so political collisions, which are the sensations of mankind, gradually shape human reason". In this way "pure reason emerges from the chaos of the centuries, and its laws reunite all men in a single family". Political revolutions are the necessary outcome of previous history, and "we cannot stop the work of time, which is founded on our own physical constitution and on our relations with the beings that surround us". If anything, we can accelerate it: so "the light of the sciences armed the republican courage in France and reason [...] has produced in six years the work of six centuries". Venturi was certainly right when he remarked that Neapolitan Jacobins owed a great debt to the thought of reformers like Filangieri and Pagano. And, as a matter of fact Pagano and Cirillo joined the Jacobin movement. Lauberg's political writings show clearly the stamp of Neapolitan historicism and of Vico; but this heritage is transposed in the new form of a reason-led progress, where reason itself emerges historically as a natural consequence of the organic constitution of human beings. Condorcet is clearly one of the main references, as well as the authors of French *ideology* and their Neapolitan counterparts, such as the Melchiorre Delfico. The idea that reason should be left free to naturally develop and grow, both at the individual and to the social level, is also central to Lauberg's teaching. In a letter to the editors of the *Journal of the Italian Patriots,* Lauberg recalls his own experience as "preceptor of the young"[63]. The students of the university of the "regenerated" town of Pavia had been complaining about traditional teaching, asking their professors for "useful notions"[64]. Lauberg points out that the young, not "corrupted" by interests and prejudices, can be educated best by simply following the natural inclination of their minds. This means starting from "very simple principles", then moving to their applications and down to their very last consequences. Young minds follow "easily" such a natural order, whatever the discipline. Given this natural inclination, it is obvious that students complain about their teachers, who regularly "oppose the progress of their reason". Most interesting is the remark that often old-fashioned professors of chemistry or physics "oppress the students with the infinite series of their detailed experiments". This can be read as a precise criticism against the dominant empiricist approach to the natural sciences, where the elaboration of hypothetical systems is avoided in favor of the contemplation of nature, and of an apparently a-problematic collection of data. Such an approach can be related to the stream of

Newtonian scholasticism which was popular in Italy through the eighteenth century, and that was being revived in late 1780s Naples by the teaching of Nicola Fergola and others.

"Natural reason" is a key-concept in Lauberg's arguments. The defense of natural reason legitimizes both his cultural battle and his political battle. In 1798 Lauberg gave one of his many speeches at the Constitutional Circle in Milan, which was part of a network of circles created to "educate the people" and to "explain to the people the democratic truths"[65]. Lauberg attacked what he defines as "the two tyrannies", namely superstition and despotism, which "sustain each other and with their weight oppress the centuries and the generations". He exhorted his public to find in true knowledge the first weapon to demolish "imposture and throne". His speech is unusually philosophical:

> Republicans, the slaves have until now looked for justice in imaginary archetypes; you study the man – he is sensitive and his relations [with external reality] will show you the true ideas of good and evil. Tyrannies imagined a being invested with their own attributes in order to justify their crimes; you are rational, so look to your own reason for the model of your operations. Nature is not a vain name, it exists, and its existence confounds itself with the eternity of the centuries. It is indeed active, and its ultimate, imperceptible molecules are forces that, with their necessarily constant action, produce every phenomenon within the universe. This is what you should study, in order to find your way among [philosophical] systems. If you depart from its principles, you will fall in the inextricable labyrinth of human opinions. Man does not need mysteries but facts [...] [66]

So Lauberg spoke to the citizens crowding the Constitutional Circle in Milan. One wonders how historians could dismiss Lauberg's early scientific activity as "a cover" for his political conspiracy[67]. It's evident, on the contrary, that Lauberg's political action and his scientific investigations were strictly linked, and that they were shaped by a common "way of thinking". What did it consist in, more precisely? In order to answer this question we must turn to his scientific output. But before that, let us complete our picture of Neapolitan Jacobin thought.

3.5 Other Sources for the Study of Neapolitan Jacobin Thought

The scientific foundation of the Jacobin political program was shared by every other significant ideologist of the movement. The most representative text of Southern

Jacobin thought, and in fact its only complete and organic presentation, was a bilingual (Italian and French) volume titled *Catechism of the Rights of Man* (1794)[68]. The text reproduced and commented upon the *Déclaration des droits de l'homme et du citoyen*, which introduced the French Constitution of 1793, whose centrality for Neapolitan Jacobinism has already been remarked. The authors were two "Jacobin priests": Ascanio Orsi (1770-?) and Michele de Tommaso (1765-1830). Orsi was linked to Lauberg and had participated in the conspiracy since 1792; he was indeed a member of the Deputy Club. He had been arrested in 1794, but had managed to escape, and to join the Jacobin organization in Northern Italy. He was an activist and a teacher of "Morals, Natural Rights and the French Constitution" until 1796, when he entered the republican police in Milan. De Tommaso had been a strict collaborator of Lauberg. In 1794, he had managed to flee Naples before being arrested. In Northern Italy he was the assistant of Lauberg, then a teacher of "Elements of Mathematics and Analysis of Sensations". He also opened a private school of philosophy. The 1794 *Catechism* was completed in the French occupied town of Oneglia, on the Italian *riviera*. Local patriots had established there a Jacobin Republic, and the atmosphere was certainly favorable to the enterprise. The *Catechism* became a textbook in the republican schools of Northern Italy and a reference for any further activity of Jacobin propaganda. The *Declaration* of 1793 was an extremely radical document, where "equality" is the first and most important right (as opposed to "freedom", which prevailed in the 1789 declaration). The first eleven pages of the book are an introduction to the principle of sensationalism, which is taken as the scientific foundation of the *Declaration*. Then the *Declaration* itself is commented on article by article. The goal of society is "common happiness", which is defined as the full possession for everyone of the basic rights: "equality, freedom, safety, and property". "Equality" means in this context "natural equality": every man is made in the same way as any other man, so that they share "the same needs, passions, faculties". Equality must be established and preserved in society by means of laws. Laws are the "expression of the general will". Laws which defend particular interests are thus illegitimate. The only way to discriminate in the disposal of posts and charges must be merit. "Freedom" consists in doing whatever does not harm others. It follows that religious freedom and freedom of expression must be guaranteed. "Religion is a matter which cannot be judged by us, only by God", the authors claim. When it comes to government, we read that it must not "oppress the individuals"; and this means that "those who rule must themselves be subject to the laws, so that they cannot abuse them". About the right of "property", this consists for a citizen in "freely disposing of his own possessions". The sovereignty is of the people, "the one and only nation". Sovereignty is indivisible and inalienable. The right of insurrection and of tyrannicide are consequences of the principle of popular sovereignty.

Other pamphlets —mostly anonymous— were to appear in Naples in 1799, to celebrate the birth of the republic. Recurrent themes were that Neapolitans "are not rebels against a sworn Government", the abolition of all the "particular jurisdictions", and the return to a "pure religion" [69]. A couple of days before the declaration of the Neapolitan Republic, in January 1799, the *Patriotic Journal* (*Giornale Patriottico*) published a bilingual "Letter of a Neapolitan Patriot to the French" by Ignazio Gentile, where a coherent political program for the republic was outlined[70]. At home, the decisive battle was that over popular education. Again: sensationalism is the scientific foundation of the Jacobin social and political project. Neapolitans have to study themselves, because "the examination of ourselves yields to the examination of our faculties, and that of our rights and duties; it convinces us that our freedom is inalienable, and that we cannot be happy unless we are all equal; and on this all the social virtues depend, and political virtue as well, and love for the home country and for the laws". "To be equal" is defined in physical terms: "the reaction of all the diversities among two citizens is always to be equal to the constant action of each one's rights and duties"; whereas "to be free" is to obey the general will as a citizen and the proper will as a man". These are "the two points from where laws begin and return, being analogous to those of Nature". This makes republican government one "founded directly on the nature of man, and of his faculties"; his "portrait" is in fact "the Temple of Nature". Religion is hardly a topic in Jacobin literature. Apart from the political anti-curialism, Jacobins tend to consider religion as relative to the personal sphere, and as such it escapes any form of social sanction. The policy of the 1799 Republic will confirm this trend, which is already clearly expressed in the Jacobin *Catechism* of 1794, by devoting almost no attention to the issue.

3.6 Lauberg's Analytic Program: from Mathematics to Society

Lauberg's revolutionary career began around 1792. But by that time he was already known in the scientific circles of Naples as a teacher of mathematics and chemistry. A man with a passion for Lavoisier and Lagrange, and many enemies in the academic establishment, Lauberg was the first son of a lieutenant of a Walloon regiment in the service of the King of Naples and, following the family tradition, he had entered the Royal Military Academy as a cadet in 1771[71]. Here he met some of his future comrades, such as Gabriele Manthoné, who was to be the head of the republican army in 1799. The Academy was at that time directed by Colonel Giuseppe Parisi. Parisi and his professors were linked to the "enlightened" branches of freemasonry, and they were remarkably philo-French in their cultural and political orientations. Pupils of the Military Academy studied French language as a means of access to French scientific culture. Colonel Parisi was a supporter of scientific exchange between European countries and he himself organized missions of students to visit relevant engineering sites all over the continent. Lauberg did not enter a military career though, being inclined to the study of philosophy, mathematics, and apparently, to a religious life. In 1777 he became a secular priest in the congregation of the *scolopi* (*Chierici Regolari delle Scuole Pie*), which had been founded in the seventeenth century to provide free education to the young from poor backgrounds. The course included, at its higher level, mathematics, philosophy and theology. French biographers report that Lauberg had studied natural sciences and medicine with Domenico Cirillo and Angelo Boccanera[72]. Around 1787 Lauberg was sent by his congregation to Chieti, in the province of Abruzzi, to teach philosophy. He wrote a textbook of philosophy of chemistry for his students, which was printed in Naples in 1788[73]. The book was dedicated to Minister Acton, responsible for the reform of the Neapolitan army (1785-88), who is thanked on behalf of his father and brothers (who, we may suppose, benefited in some way from the reform). To Acton was also dedicated the second work published by Lauberg in the same period, *Reflections on the Operations of Human Understanding*[74]. In this epistemological piece, Lauberg refers to French and British philosophers (he read both languages), placing himself in the stream of Genovesi's Lockean empiricism. Indeed Lauberg followed the orthodoxy of Genovesi's school when he remarked that after centuries of vain speculations on the soul, Locke began "to investigate the phenomenon of thought, teaching to his followers Condillac, d'Alembert, Diderot, Buffon, Bonnet", the method "to reconstruct the history of human understanding", and "the order by which man proceeds in acquiring his knowledge". The question of the "natural order of ideas" is the crucial point in Lauberg's version of that sort of *ideological* and sensationalist current which became influential in Naples in those years. "Only a well directed analysis of the operations of human understanding can clarify the development of our ideas and the order according to which they follow each other". Lauberg's aim was that of presenting a short version of this epoch-making revolution to his students. The influence of Condillac's sensationalism is one of the most evident features of this work, but there are points where Lauberg departs from his main source. He follows Condillac in criticizing Locke for having regarded "reflection" and "sensation" as two different sources of ideas, whereas reflection itself is founded on sensation. Reflection is indeed the sensation that the soul has of itself and of its operations. But he believes the spirit is not only passive, but also active, by virtue of its capacity of directing the "attention" towards the impressions received. Furthermore, he does not believe that the senses can guarantee the existence of an external reality. Lauberg tried to defend the assumption that external objects do exist, but he also claimed that we can only know them "relatively to ourselves", and not "in themselves". On the other hand, he seems to rule out a full-blooded materialism *à la* La Mettrie, defending a more cautious sensationalism. Lauberg argued for matter being "active", even if such activity is said to be different from proper spiritual phenomena. Also, if the reciprocal influence between human organism and human spirit is undeniable, its physical conditions are unknown (for Delfico this was not much of problem, as we have seen). In morals, Lauberg seems to follow closely Helvétius (1715-1771), grounding morality on the notion of "self-interest", or "pleasure principle" ("amor proprio", in Lauberg)[75]. I have tracked down only one other philosophical work by Lauberg: an annotated translation of a work on fatalism by the Jansenist theologian François Pluquet (1716-1790), published in Naples in three volumes in 1791[76]. Pluquet listed and commented upon a number of ancient and modern "systems" about the origin of the universe and the nature of the soul. Lauberg, in his footnotes, is invariably polemical with metaphysical arguments, and with "questions of words". He links different philosophical systems to the personality of the different philosophers, to "the circumstances of their own life". These circumstances are indeed causes of strong "impressions", which attract "the activity of the spirit", and are relevant to the construction of systems of ideas[77]. One also finds the instrumentalist conception of religion that was to be central in his later political writings. Lauberg condemns those who use religion in order to attack and "oppress" philosophical adversaries[78], and he finds the way to insert an apology for Giordano Bruno[79]. Lauberg also finds a way to refer to chemistry, "which is nowadays the most interesting branch of physics"[80]. Indeed in those years (1788, according to the French biographer) Lauberg was making experiments on a new method for the extraction of indigo from *Isatis tinctoria*; and he also tried to establish an industrial plant for the production of sulphuric acid (both processes had remarkable economic relevance). Lauberg's teaching and experimental activity did not meet with the favor of the natural philosophers of the university. A French biographer remarked that the experiments "were very successful, but they were not encouraged", and that he was persecuted by the "partisans of the ancient doctrines", because he used to teach Lavoisier in his courses[81]. Interestingly the French biographers skipped over the political activity of Lauberg, and over his major role in the Neapolitan events. In 1793 he went to France, they said, because "he wanted to participate to the scientific movement". One plausible reason for this striking lack of memory is that the notes were based on information provided by Lauberg himself in his later years, when he was living in Paris under the restored Bourbon, and he feared his Jacobin past could harm his career and those of the members of his family.

But Lauberg's teaching was appreciated in the Military Academy of Naples. In 1788-89 he was offered a temporary lecturing position. In 1789 a competition was organized to assign the chair of mathematics of the Academy. Lauberg submitted an essay but this time he failed, the chair going to Annibale Giordano, a young student from Fergola's private studio. Lauberg's essay was on mechanics: he aimed to prove the fundamental principles of the science of motion "in an easy and direct way [*con vie facili e dirette*]"[82]. The first step consisted in stating clearly "the conventions that are at the basis of this science", and in deriving the laws of mechanics from them "through simple induction". Once such preliminary work is accomplished, "the solution of every problem is reduced to a matter of pure calculation". These considerations, Lauberg continued, made him decide to study mechanics "by means of new analytic views [*con nuove analitiche vedute*]". Following the very recent example of Lagrange (1788), Lauberg aimed to show that all theorems of mechanics are merely different expressions of a unitary principle, the axiom of virtual velocities. Lauberg's analytic approach to mechanics relies on certain fundamental beliefs about the nature of the sciences, which are connected to his sensationalistic epistemology. "Every science" he wrote, "is nothing but the combination of all the simple ideas which constitute the complex idea of a phenomenon, and of the conventions that have been established". In the case of mechanics, we know that

> all bodies are active beings, and are in movement: thus there must be a general expression that comprehends all the combinations of simple ideas constituting this phenomenon of the bodies' activity [force, distance, time], which will give us the general equation to obtain the solutions for all the particular problems of mechanics. [83]

By means of this general equation, Lauberg argued, we can mechanically obtain the solutions for every particular problem of mechanics, regardless of any metaphysical consideration about the "essences of the bodies", the "nature of the forces", and the "useless" questions such as "whether the force is intrinsic or extrinsic to the body". Importantly, Lauberg stated that his analytic approach is not limited to mechanics, but can be employed in "every science".

Later attempts of Lauberg to obtain a university chair in 1791 and 1792, in Experimental Physics and Natural History respectively, also failed. But in the meantime, he was making his name outside official teaching. By 1792 he had left the religious congregation, "to be a man of letters and a professor of physics and mathematics"[84]. In fact he had been running a private studio in Vico dei Giganti, since 1790. In May 1792, as we have seen, he founded the "academy" of Santa Caterina, where he taught with the assistance of Giordano. In 1792 they published their own textbook of elementary mathematics, entitled *Analytical Principles of Mathematics*[85]. It consisted of two parts entitled respectively "Principles of Arithmetic" and "Principles of Geometry". The sciences of arithmetic and geometry are here "analyzed", that is, reduced to their most simple, elementary notions and laws, and then re-built according to the "natural order" in which our own thoughts tend to be actually structured. The "natural order" turned out to be the order of algebra. In the preface, the authors clarify which image of mathematics they support[86]. As in the 1789 essay on mechanics, Lauberg merges sensationalist epistemology and analytic methodology. The whole of human knowledge, it is said, derives from "very simple sensations", which are the basis for the construction of our concepts. The cognitive content of every science derives from a particular class of sensations, and from the conventions stipulated by human beings about them. Between elementary sensations and general scientific laws there is a "necessary link". This link is provided by algebraic reasoning, thanks to which phenomena are "connected to each other with analytic order". The science of mathematics, for example, derives from the class of our basic sensations and conventions about magnitudes (which is the phenomenon studied by this science). Physics is "the generalization of phenomena resulting from the activity of matter"; it is not "that crowd of substances and qualities whose only utility was to teach us words without meaning [*vocaboli privi affatto di idee*]". Similarly, metaphysics has been freed from "the darkness with which the [philosophical] schools had surrounded it". This science consists, in fact, of two main branches: the study of human sensibility, and the investigation of those general physical laws called "cosmological laws". Morals are "merely" the analysis of the sensations caused by human needs, and of the means to manage them; politics is limited to the problem of satisfying individual needs within the satisfaction of general needs. The authors conclude that:

> [I]f Physics, Metaphysics, Morals, Politics are merely the analysis of the effects of the activity of matter, of human sensibility, of the control of this sensibility relatively to human needs, as Mathematics is the analysis of quantity; then, Mathematics being an exact science, so also must we consider the other ones, when we regard them without mystery, and from the right point of view.

In every science, we must investigate "the natural development of the simple ideas constituting the primitive phenomenon which is the object of the science itself". This natural development of primitive ideas is given, in any area of human knowledge, by rules of algebra and calculus. It is by now clear that the choice of the analytic method as *the* method in mathematical textbooks is a crucial step for the whole political and scientific-philosophical enterprise of Lauberg and Giordano. If we aim, the authors wrote, "to promote public education, and to eradicate the old prejudices, the only way [...] is to accomplish this simplification of the sciences, so that —reduced to the analysis of our sensations— they no longer constitute that congeries of isolated truths which is presented by the method of Composition [i.e., the synthetic method]". Presenting geometrical truths to students by means of the synthetic method is confusing because in synthetic reasoning there are no traces of the necessary connections which our mind naturally recognizes among them. Truths are just presented as a non-ordered lot, a random collection. The student has to acquire the very general method to discover every geometrical truth, not a few disconnected and local truths. Analytic method is then the key to access that universal "chain of truths" which had already been theorized by Neapolitan freemasons, and which is now assumed as a model for scientific disciplines by the Jacobins. "These considerations", the authors continued, "made us regard the textbooks of mathematics and philosophy compiled according to the synthetic methods as unworthy of the education of man". Indeed these books "present a history of the single truths, instead of presenting the methods of invention which contributed to the development of human spirit". The synthetic method presented the pupils with a set of disconnected, particular truths (in geometry, the more skilled we are, and naturally gifted, the more we can find out new geometrical truths), while the analytic method was a "complete" and universal one. It was, so the argument went, the method which opened a new era for the mathematical and empirical sciences; it was the method that would permit the development of social and political sciences in the near future. "We decided to prepare this textbook according to the view that we have presented above" they concluded, "with the only aim of being useful to our Country".

The Jacobin project of social, political and cultural "regeneration" was grounded on the universal applicability of analytic method, that is on the employment of the analytic style of reasoning to connect and structure the cognitive content of every branch of knowledge. To "regenerate" a people meant to let them discover the functioning of their own mind ("republicans, study the man!" proclaimed Lauberg in his speeches), in order to find the sources of the values of good and evil, of morality and immorality, of right and wrong. The method to be employed in this investigation was the "analysis of our ideas", i.e. the breaking down of complex into elementary ideas, deriving from simple sensations; this material was then to be re-structured according to the analytic method to naturally reach the new complex ideas. To "regenerate" a branch of knowledge meant, analogously, to analyze it into its elementary ideas (sensations and conventions) and then to re-structure it according to the analytic method.

On the nature of mathematics, Jacobin practitioners claimed that mathematics was not a question of individual intuitions, of difficult and long training, and its aim was not limited to the discovery of eternal truths in the heavenly kingdom of geometrical entities. On the contrary, mathematics was a universal language, comprehensible to every rational being, which can be applied to every field of human experience, even to human sciences (as for the reformers, no epistemological or ontological divide exists among the two branches of knowledge). They can be mathematized, and they can reach the same degree of certainty which is proper to mathematics. This implied that the whole existing social and political setting could be criticized as "unscientific", and that it could legitimately be re-built on the basis of the new theorems of the sciences of politics and economics. Once their "very simple elements" had been well defined, it would be possible to deduce the laws of the social sciences in the same way in which it had been done for those of hydrodynamics[87].

3.7 Other Jacobin Mathematicians

If Lauberg and Giordano were the two most popular analytic mathematicians in Naples at the turn of the 1790s, they were not the only ones. Consider the scientific and political activity of Vincenzo de Filippis (1749-1799), from the province of Calabria[88]. Like many of his generation, Filippis went to Naples to study law. After having completed the studies, he was employed as an administrator by a landowner in his native province. But he soon decided to follow his inclination for the sciences, and he won a place at the *Collegio Ancarano* in Bologna, where at that time noteworthy mathematicians and physicists were teaching, such as Gerolamo Saladini (1731-1813), Vincenzo Riccati (1707-1805), Paolo Frisi (1728-1784) and Ruggero Boscovich (1711-1787). He obtained the *laurea* in philosophy in 1773. Back in Naples, he was in contact with Vito Caravelli, possibly his former private teacher, and he visited the naturalist Nicola Pacifico (1734-1799). In 1779 Filippis was in Naples "for certain affairs"; on this occasion he bought the works of d'Alembert, and he was asked to enter the new RAS. In the 1780s Filippis was involved in debates over the economic reforms of the province of Calabria. He hailed enthusiastically the suppression of monasteries in the area hit by the 1783 earthquake; and in his correspondence he praised the works of the reformers Gaetano Filangieri, Antonio Planelli, and Francesco Antonio Grimaldi. He completed an essay on the Calabrian earthquake where the phenomena preceding and following the event were analyzed, and the most likely explanation suggested, which was that of an underground electrical accumulation. The social and economic consequences of the earthquake were also analyzed. Filippis was again in Naples in 1786, where he met Donato Tommasi and other reformers of the capital. In that year Tommasi was organizing the new anti-despotic lodge of the *Illuminati*, to which most of the reformers belonged, including Filangieri, Pagano, and Pacifico. According to his biographer, it is very likely that Filippis entered the lodge as well. He presented to his Neapolitan friends a manuscript on mechanics, which was favorably received and commented on. Mechanics was described as "the most important and useful science of nature", and "the source" from which originates every other physico-mathematical science. Mechanics also enjoys, according to Filippis, "metaphysical and mathematical certitude", given that all its conclusions derive from a few basic evident principles through mathematical reasoning. Between 1787 and 1792 de Filippis taught mathematics at the Royal Schools of Catanzaro, in Calabria. We are told that his lectures included "practical" parts, where Filippis discussed applications of the sciences to the wealth of society, and to morals. In 1789 he was in Naples again, this time to study Lagrange's mechanics. The new cultural atmosphere of the 1790s soon affected Filippis' career and life. His close friend and colleague, the mathematician Gregorio Aracri (1749-1813)[89], was accused of atheism by religious authorities. In his *Elements of Natural Law* (1787) Aracri, who was a priest, had defended the thesis that moral laws are innate in human nature. The attack was against an ecclesiastic, but the real targets were Jerocadès and other Calabrian reformers and freemasons, including Filippis. In 1792 Filippis left his post at the college of Catanzaro. In 1798 he was interrogated about the Jacobin conspiracy, but we do not know about the result of the investigation. In January 1799 he was a member of the Jacobin provisional government, and in April he became Minister of the Interior of the Neapolitan Republic.

Abbé Nicola Pacifico (1725-1799), as we have seen had scientific and, possibly, Masonic contacts with de Filippis[90]. He had been trained at the Archiepiscopal Seminar of Naples, where a rather good scientific education was provided[91]. In 1779 he was chosen as a pensioner member of the RAS, in the class of Natural History. He was enrolled in the Great National Lodge and, later on, in the reformist and anti-despotic lodge of the *Illuminati*. He wrote a memoir on the Calabrian earthquake of 1783, for which he suggested an alternative explanation to that of electricity. More interesting for our present purposes was his plan of research presented at the RAS for the years 1780 and 1781, which included "improvement of the methods for the study of convergent series, for the integration of differential formulas, and extension of their use; particularly to find a series more convergent and more practical for the rectification of conic curves"; "to promote the elegant theory of the reduction of the integration of certain differential formulas in the rectification of conic curves"; to clarify certain points of the "analysis finitorum" (theory of equations) [92]; furthermore he planned to extend "his philosophical considerations to agriculture and trade"[93]. This was quite a wide program for a member of the class of Natural History. Note the interest in branches of analysis, in the practical applications of calculus, and in political economy. Not surprisingly "among his dearest friends" were Filangieri, Cirillo and Caravelli[94]. The "choice library" of Nicola Pacifico was always open for Nicola Fiorentino (1765-1799), a former student of Saladini and the author of an *Essay on the Infinitesimal Quantities and on the Live and Dead Forces*[95]. He wrote the essay to intervene in a debate about the nature of infinitesimal quantities his aim being that of showing how differential calculus can be grounded in geometry, so that he can conclude that "all this calculus is exact, and free from any imputation"[96]. But Fiorentino is mostly known for his essay on "the public economy of the Kingdom of Naples" published in 1794, when he was professor at the Royal College in Bari, Apulia[97]. It was the last study in the reformist tradition. Fiorentino offered an analysis of the present miseries of the country, and of the constant oppression of the poor and of the "gentlemen" ("uomini dabbene"), which both originate from "our ignorance", particularly in agricultural matters[98]. Too many people study law, while agriculture is abandoned to itself as if it were an easy art. But it requires indeed a great amount of knowledge to rationalize agricultural production, and every innovation has to be introduced fighting "against the great force of prejudices"[99]. The unchanging conditions of production show that the teaching of Genovesi had been largely wasted, Fiorentino argued. He also called for tribunals and schools to be reformed and to be established all over the kingdom, ending the secular concentration of juridical power in the capital. Universities should be opened in the provinces, and chairs of agriculture should be established, as this discipline is the most important for the nation. Academies of agriculture should be encouraged, grouping professors, physicians and landowners[100]. A new code of legislation should be introduced. The end of the feudal system and of the partial juridical systems would make it easier to invest in productive enterprises and this would improve agriculture, trade and manufactures[101]. The link between science and economy was crucial to Fiorentino as it was to the other reformers: trade and nautical science depend "necessarily" on the sciences of mathematics, physics and chemistry[102]. But in Naples, Fiorentino says, there are at most "buoni elementisti" (good writers of textbooks). Specific institutions should encourage "professors of pure and mixed mathematics" to cooperate with engineers and other scientists[103]; the families should address their children to the study of the sciences; and investments in agriculture should be made compulsory[104]. In the present agricultural system (the "badly-understood agriculture") people are merely employed to survive; instead, agriculture should provide new capital, and increase the wealth of the nation[105]. Other claims concern the importance of a free-trade legislation[106], and the abolition of import taxes in order to increase internal competition[107].

These and other similar stories of scientific and civil passion contain a recurrent pattern. Young students from the provinces of the kingdom are sent to Naples to study law or medicine, or to enter a military career. They generally complete the studies, but then are captured by scientific passion. They are attracted —in particular— by the mathematical sciences and by their applications to practical problems, from mechanics to agriculture. They study abroad or, if in Naples, with an unorthodox teacher such as the Bolognese Gerolamo Saladini, or again with Vito Caravelli (either privately or at the Military Academy). The most brilliant ones end up teaching at the Military Academy, while the others generally get posts in provincial colleges. Very few have links with the RUN. The oldest ones took part in the movement of reform of the 1770s and 1780s, and support the claim that the sciences have to be useful to the civil progress of Southern society. They join the "progressive" branches of freemasonry; in 1786 they are grouped in the lodge of the *Illuminati*. At the turn of the 1790s they are attacked by the most conservative elements of the Neapolitan Church, whose influence is rapidly growing on the government. Common accusations are those of "atheism" or "indifference" in religious matters. In 1794 they are more or less directly involved in the Jacobin conspiracy. Their participation in the Jacobin Republic of 1799 was to be crucial. Scientifically, they all teach algebra and infinitesimal calculus showing no interest in pure geometry; they are chiefly interested in the application of calculus to mechanics and to the physical sciences; they believe that the certainty of mathematics can be introduced in other branches of human activity, once they have been rationally re-ordered. They are fascinated by the rational construction of Lagrange's mechanics (where the whole science of mechanics is analytically derived from a few fundamental principles), and in their later works they refer to his algebraized version of calculus.

3.8 Jacobins on Religion: from Institutionalized Knowledge to Personal Faith

From what we have seen up to now, the ex-*scolopio* Lauberg had been violently anti-religious in his Neapolitan years. In his political speeches and articles of the period 1796-1799, he continued to condemn institutional religion as an instrument of oppression in the hands of political power, but he seemed more sensible to the question of a spiritual inclination in human beings. In 1797 Lauberg gave a speech at the Constitutional Circle in Milan where he supported the diffusion of Theophilanthropy, the cult born in France in 1796 to replace Christianity as official religion[108]. Catholic reaction to the French Revolution was indeed growing in strength in France and in Italy, and it was being particularly successful in gaining popular support. The introduction of the Theophilanthropic cult was a response to this threat. Theophilanthropy was directly opposed to Catholic Church and to its temporal structures; so that Catholicism could be held responsible for supporting despotism and feudalism, without condemning religion *tout court*. There was something like a "pure core" which should be extracted from the corrupt structure of Catholicism, and preserved. The Constitutional Circle in Milan had among its duties that of diffusing the Theophilanthropic cult. Matteo Galdi, former student of Lauberg and the president of the circle, also proposed (in an *Apostolic Letter*) to search for a church in the city to be consecrated to the new cult. In spite of these efforts the cult was not to be successful in the Italian "regenerated" towns. Others, such as the Jacobin priest Giovanni Ranza (1741-1801), were more inclined towards a return to the simple Christianity of the primitive church[109]. This direction was also advocated by the Jansenist priests, who had joined the Jacobin movement in significant numbers[110]. Unlike Theophilanthropy, these rigorous forms of Christianity had a long tradition inside Catholicism, and they were well grounded in specific sectors of the Italian middle-classes. In Naples, most of the eighteenth century fight of the Crown against the Roman Catholic Church had been conducted by Jansenist clergymen. The expulsion of the Society of Jesus had indeed been one of their great victories. They had been less successful in trying to eradicate those forms of superstitious religiosity which were typical of the Neapolitan populace. On the 25th of December 1797, Lauberg gave a speech at the circle. The speech was on religion, on the "purest cult" that should be offered to the "Supreme Being"[111]. He praised religious freedom, granted by the constitution of the Cisalpine Republic. It is not in the power of men to condemn someone for his religious beliefs, he argued. He then explained the meaning of the new cult, which implies love for the Supreme Being as well as for our fellow humans. Indeed, this is the basic tenet of most of the traditional religions, once they are purified of their temporal structures. Few basic principles characterized this "regenerate" religion: God created all men equal; he has put in their heart the aspiration to conservation and happiness; but individual happiness depends necessarily on public happiness, so all our efforts must be directed to the well-being of the entire society. This cult is indeed the most "conformable to reason" and "advantageous to society". Lauberg concluded: "let us enter the temple of Reason, daughter of God"[112]. The following day the frequenters of the circle agreed that the cult was the most "conformable to nature, to reason, and that it was worthy of republicans"[113].

The polemic against papacy and clergy was intense in those days, and Lauberg offered his own contribution. He maintained that the properties of the Church were to return in full to the people, and he described the Pope as, at best, an "assassin"[114]. Plans were made for a military expedition against the State of the Church. The atmosphere of those crowded and lively assemblies is well rendered by episodes such as that of the young citizen Sangiorgio, daughter of the chemist Paolo Sangiorgio (1748-1816), who jumped on the stage and promised her hand to the one who would bring back the head of the Pope[115]. When the "theocratic tyrant" was in fact defeated and departed from Rome, Lauberg hailed the victory of both republican arms and philosophy. "The monster" – superstitious religion – has been defeated in Rome, and now "philosophy hunts it down in the most hidden refuges, and in the heart of man". Against the attempts to restore the old monstrous principles it will be enough to employ "the weapon of ridicule": "we will laugh at the Gothic sacerdotal barbarism which is being prepared"[116]. In 1798, while directing the newspaper *Il Redattore*, official organ of the Executive Directoire of the Cisalpine Republic, Lauberg collaborated with a Neapolitan friend, Raffaele Netti (we cited him earlier as a friend of Giordano and the organizer of a Jacobin *conversazione*). He too had fled the country in 1794, to settle in Milan as a bookseller and an editor. Netti is an extremely interesting case of a revolutionary intellectual, and his work should be further investigated by historians. His Printing-Office of the Italian Patriots (*Stamperia de'Patrioti d'Italia*) was characterized by publishing violently anti-religious books and pamphlets. Between 1798 and 1799, Netti published texts like the *Democratic Institutions for the Regeneration of the Italian People*, by the Jacobin Girolamo Bocalosi[117]; *Le bon-sens, ou idées naturelles opposées aux idées surnaturelles* by d'Holbach; *Cult et loix d'une Société sans Dieu*, by Sylvain Maréchal, one of the numerous and anonymous *Traité des trois imposteurs*, and the *Hell Destroyed, or Examination of the Dogma of the Eternity of Punishments* by Nicanore Nicomaco (a pseudonym), where one reads: "Priests! Archimedes looked for a point outside the world in order to move the world itself. You have found it !" Among the forthcoming volumes, *Le christianisme dévoilé* by Nicolas-Antoine Boulanger (1722-1759), the *Sistème de la nature, ou des lois du monde physique at du monde moral* by d'Holbach, and an anthology of passages against superstition by eighteenth-century philosophers were listed[118]. Lauberg had also translated and edited Helvétius' *L'Esprit*, specifically to show to the Italian young the "horrors caused by [the alliance of] mitre and throne"; Lauberg thought that France itself had not done enough in this direction. He is caustic against contemplative monastic orders, whose members "when not doing wrong, are perfect nothingness" and against any form of useless anachoreticism[119]. One should note that Netti did not exclusively publish books against religion. In 1798 Lauberg translated for him three volumes of the *Lectures for the Normal Schools of France*, which included essays by Lagrange, Laplace, Monge, Volney and others; and he planned to publish a volume of *Republican Speeches*. Again, the two sides of the Jacobin battle —scientific and socio-cultural— seem to be inextricably embedded in the activity of the Neapolitans.

In 1797 Flaminio Massa, a former student of Lauberg and a disciple of Mario Pagano, was in Pavia, studying mathematics with the well-known mathematician and Jacobin Lorenzo Mascheroni (1750-1800), who was a deputy of the Cisalpine Republic. Massa published a *History of the Establishment of Christianity*, allegedly by an anonymous "English author"[120]. In his notes, Massa aimed to ground the morals of the virtuous citizen on a very different basis than "the monstrous building of scandalous tales" that "criminal fanatics" and "certain enthusiastic philosophers" have being defending. Massa referred with blasphemous tones to the removal of the Madonna di Loreto by the French, and to a public experiment conducted at the University of Pavia by a certain "professor Nocetti" where the miracle of Saint January had been reproduced using chemical substances instead of dried blood. The meaning of such a result could not escape a Neapolitan, given the particular devotion of the Southerners for the beheaded saint. It has been remarked that the violent tone of the anti-religious campaign was indeed a distinguishing trait of the productions of the Neapolitan Jacobins with respect to Jacobins from other Italian states[121].

To sum up, Neapolitan Jacobins directly attacked the institutional dimension of the Roman Catholic Church and the use of religious knowledge as an instrument of power. They identified the specific function of institutional religion in the traditional socio-cultural system. Yet, the destruction of the Church did not imply the refusal to recognize a spiritual inclination in human beings. New substitutive — and rather artificial— cults were supported with the aim to reinforce the civil commitment of citizens. More interestingly, the consistent Jansenist component of the Jacobin movement proposed to return to the original simplicity of early Christianity, leaving aside both the baroque religiosity of the Jesuits and the temporal ambitions of the Roman Church. This call for a regeneration of religion was indeed rather successful in Naples, particularly among the lower clergy and the middle-classes. Essential features of the religiosity supported by the numerous "Jacobin priests" were the need to retire from the mundane sphere, and the move away from religion as knowledge to religion as personal belief. As Lauberg said, religion must not be a matter of legislation. The exit of religion from the realm of knowledge is very clearly stated in the epistemological work of a Jansenist abbé who had been a friend and collaborator of Lauberg in Naples, Gennaro Cestari (1753-1814).

The brother of Giuseppe, whom we encountered when dealing with the protagonists of the Jacobin conspiracy of 1794, Gennaro Cestari had studied at the seminar of Naples in the 1770s, under the guidance of the Jansenist ecclesiastic Giuseppe Simeoli. The seminar was at that time relatively open to French philosophical and scientific culture, in spite of official prohibitions. Descartes and Condillac were already well known by Cestari in his years at the seminar as, in theology, was Gallicanism. In 1780 he published an anti-curial pamphlet in defence of the rights of the king upon Episcopal benefits and, in 1788, a very successful book on the right of the king to create bishops, which was reprinted after a few months[122]. The book was radical in attributing to the king the right to create bishops and in denying any supremacy of the Pontiff over the Episcopal community; the Papal authority is indeed reduced, through historical analysis, to a matter of "habit". The Archbishop of Naples defined the book as "scandalous, seditious, dangerous in itself and for its consequences". Ecclesiastical authorities denied permission for publication. But, in August 1788, the minister of Ecclesiastic Affairs Carlo De Marco[123] —in an unprecedented act of autonomy— claimed that the book was not heretical, and questioned the very right of the Church to practice preventive censorship over books printed in the Kingdom of Naples. The book was published, and it was praised by regalist and Jansenist theologians all over the Italian peninsula[124].

Gennaro and Giuseppe Cestari had both entered Neapolitan "enlightened" freemasonry, and they both joined the Jacobins at the establishment of the Neapolitan Republic in 1799. Gennaro was indeed charged to write the official Christian Catechism of the Republic. His reward for this, at the return of the Bourbons, was arrest and exile. By 1803 Gennaro Cestari had settled in Milan. He was reflecting and publishing on the Jacobin experience in Naples, and on its wider cultural implications. For Cestari, as for Lauberg and the other Neapolitans, the "regeneration" of humanity included the regeneration of society, of the morals[125], of the sciences and of religion. And the "organic system" of the "regenerated sciences" is what Cestari described in his *Essay on the Regeneration of the Sciences* (1803)[126]. The book is an extremely interesting —and rare— document on the epistemological doctrines of Neapolitan Jacobins, and on the modifications they introduced to the model of the French *Encyclopédie*.

Cestari was convinced that, contrary to common opinion, the sciences were in need of new foundations. Indeed, he spoke for all those "dissatisfied with the present state of human knowledge"[127]. Contrary to those who believed that the sciences were at their highest point, and that only a natural decline could be expected (e.g. Boscovich, or Algarotti), Cestari claimed that the accumulation of scientific knowledge was only at its beginning[128]. He compared the construction of the system of the sciences to the construction of a "complex machine", each of its parts having a precise function. Similarly, sciences have to be mutually linked "to form a single whole"[129]. This provides the "texture of the general system"; then each science has to progress properly, otherwise the whole system works imperfectly, as "a machine whose pieces are not fulfilling their proper function". Now, the means "to recognize the internal and original structure of the system" was twofold. On the one hand Cestari provided a historical reconstruction of the way in which the system of the *Encyclopédie* had been formed ("an historical and progressive guide", a sort of genetic investigation[130]); note that this should not go back to Greek and Roman thought, because "they had no influence on the formation of our present system"[131]. From the genetic investigation it emerges that the sciences are not yet free from the "ancient barbarism", which is well entrenched in language and in the doctrines taught at the universities. Much of the old philosophy has indeed entered the system of the *Encyclopédie*[132]. These defects are analyzed in the second — "structural"— part of the book. "It is necessary to create a new foundation for the whole scientific system, in order to build a completely new order of things, more coherent with the real progress of the human spirit" Cestari claimed, and to do this the sciences must be re-ordered according to their relations with the sources of knowledge: this is indeed what "re-generation of the sciences" means[133]. Cestari presented his enterprise against the background of an accurate critique of d'Alembert's *Discours préliminarie*, whose analysis exceeds our present purposes. Let us sum up Cestari's basic remarks.

First of all, the *encyclopédistes* have included too much. They betrayed their original intention of considering only those branches of human knowledge which are worth their name: that is, the "clear, certain, real and true" ones. As the work went on, the *encyclopédistes* kept inserting topics such as "scholastic philosophy", "rhetoric", or "heraldry" arguing, in the preface to the third volume, that nothing should be left out of an encyclopedia. As a result the encyclopedia is a mix of "heterogeneous pieces of knowledge: natural, supernatural, true, false, opinions, superstitions, conjectures". Another problem is with the "harmony" of their system. The authors take for granted that a link among their heterogeneous materials does indeed exist. D'Alembert suggests the genealogical study of the formation of our ideas as a unifying factor for the system[134]. The genealogical tree and the encyclopedic tree do not coincide though, because of historical contingencies. Different systems are compared by d'Alembert to different *mappae mundi*, drawn using different projections. A "principle of arbitrariness" is thus introduced: different systems simply offer different perspectives on human knowledge, and the choice depends on personal preferences, since they are all equivalent. But then, Cestari remarked, this means that we do not know which is the universal principle from whence all the connections among pieces of knowledge derive[135]. The systems are equivalent "conjectures", their connections are "imaginary" and not real. So what about our original plan of a scientific system of true knowledge? Another problem with the *encyclopédistes* is that they are only interested in deducing and classifying the speculative faculties of the soul, without considering the "active, operative faculties", and the crucial role of passions, which are the real source of every useful invention[136].

The solution to these and other related problems lies, according to Cestari, in founding *ex novo* a new system based on the new epistemology of the *philosophes*, leaving aside Chambers' and Bacon's systems. We should look for the real principles of knowledge, and for the real chain of human knowledge. Cestari advocates rejection of the rather traditional division of human understanding into the three faculties of memory, reason, and imagination (and the correspondent division of human knowledge into three main subjects: history, philosophy, and fine arts). Bearing in mind Genovesi's Latin logic, Cestari notes that there are indeed a number of alternative subdivisions of faculties[137]. Cestari himself seems to incline towards Condillac's, who admitted only one faculty: sensibility. Overall, Cestari disliked the choice of "memory" as a primary faculty. Memory depends entirely on sensibility and perception, and on the capacity of associating ideas; it is a mere attitude to retain sense impressions[138]. Instead, the first and fundamental faculty by which we acquire knowledge seems to him to be "sensibility, or perception"[139]. He then claimed that there is also the "faculty of abstraction", which is precisely what distinguishes humans from animals, and is the origin of the sciences (a clearly Lockean echo). By abstraction human beings generalize their ideas, mix them, and proceed to the discovery of truths. All the sciences founded on the notion of "proportion, order, symmetry, calculation, cause, effect, virtue, vice, glory, etc." depend on such a faculty for generalization[140].

Having adopted a radical sensationalist epistemology, Cestari can criticize d'Alembert for his "scholastic" division between material and spiritual beings[141]. He recalled someone characterizing matter as "brute, inert, coarse, inactive, without motion, the weakest and most imperfect of all beings, vile, only worthy of being down-trodden"[142]. "He sounds like a Manicheist" Cestari commented, "but he is a modern apologist of the Roman Catholic religion". The point is that this "brute" matter does not even exist. In fact, what we see is that matter continuously changes its shapes; its compounds being organized, dissolved and re-organized. A continuous flux involves all beings, including the sensitive and intelligent ones. Elementary matter "can be characterized as brute and organized, passive and active, inert and living, insensible and sensible, depending on its different states"[143]. So we should talk of states of matter, not of matter itself (which reminds us of Pagano on the continuously changing character of nature). Cestari rejects the "coloured glasses of spirit and matter": they are useless for the investigation of nature[144]. With this rejection, Cestari reaches the crucial issue of the relation between the natural and the supernatural dimension of reality. Bacon and the *encyclopédistes*, Cestari says, divided knowledge into knowledge of God and knowledge of man. But this clearly shows "the great incongruity in placing God and nature on the same level, as objects of the same science. As if this Supreme Entity was capable of being known by man" as the sensible things are[145]. There is no such thing as a particular "science of God", and belief that it was "possible to reason about the nature and the operations of God" has always damaged "the advancement of true knowledge"[146]. Contrary to their programmatic indications, the *encyclopédistes* considered God as the first (spiritual) object of the sciences, and placed metaphysics at the basis of their own system[147]. Cestari, not unlike his fellow-Jacobins, aimed to free sciences from the "mysterious terms" of metaphysics. In fact, he says, human beings have no access to any sort of metaphysical reality, and the preeminence of metaphysics over the sciences is simply due to historical reasons[148]. Religion is not a science, and it is not based on reasoning: religion is in fact "the feeling of subjection to the Author of our being". Religion is not the product of the progress of the sciences and it is not grounded on any sort of scientific proof; it is instead caused by a "disposition" of human nature. It is "a relation between man and God", which can be understood "only by those who feel the strength of this link"[149]. This religion take many external forms, like different theological systems, ceremonies, and practices. But all these forms "have no reality" apart from that which is received from the essence of religion, i.e. the "internal feeling"; and "those who lack for whatever reason this religious sentiment cannot but regard forms of religious life as human inventions, opinions, tales, chimeras". This being so, one cannot put "the theological systems and the different forms of cults of the different nations" together with "arithmetic, algebra geometry, mechanics and astronomy" without making "terrible mistakes". Forms of cults can be classified, at most, under History, together with other kinds of opinions and practices. Cestari concludes his work with these remarks on the relation between natural knowledge and revealed doctrines[150]. A "separating wall" must be constructed between "pure reason and reason enlightened by Revelation", between "divinely revealed doctrines and human speculations", between the human mind and the human heart. This would bring "multiple advantages": sciences would not be distracted by extraneous questions, and revealed religion would not depend on inconstant speculations.

This is how the Jacobin priest Gennaro Cestari, who never rejected his Christian faith, presented the epistemological shift operated by Neapolitan reformers and Jacobins. As a result of this shift, legitimate knowledge was defined as only that grounded on human sensibility and on human natural reason. The epistemological divide between the material world (known through physics) and the spiritual world (known through metaphysics) was rejected. The *encyclopédistes* were criticized because their system still, at least formally, shared many properties of previous systems. The basic problem with their system was the subordination of the physical sciences to metaphysics. The cause of this problem lay in the fundamental confusion between religion and science. The solution, and the basis of the regeneration of the sciences, was a neat separation between science and religious belief, i.e. the expulsion of religion from the realm of legitimate knowledge.

3.9 The 1799 Republic: Apotheosis and Defeat of Neapolitan Jacobinism

In the Summer of 1794, at the beginning of the trials against the Jacobins, the White Dragons of the King of Naples were fighting the French in the Po Valley with some success. Elite cavalry units were indeed the only reliable forces the king could now count upon, considering the remarkable penetration of Jacobinism in other sections of the army. At the end of 1798 the French commander in chief of the Italian Army, General Joubert, planned the invasion of the Southern Kingdom. He asked Lauberg to join General Championnet in Rome, the starting point of the new campaign. Lauberg headed a commission of Neapolitan exiles charged with preparing the terrain for the French occupation. The French found scant resistance by the Neapolitan army, infiltrated by Lauberg's men. Instead, there was a noteworthy and unexpected resistance offered by the "low people" of Naples. It was only after three days of house to house fighting that the French entered the town, with the crucial support of the fortress's guns, in the hands of Neapolitan Jacobins. A few days before the Jacobins had proclaimed the birth of the Neapolitan Republic. The chaotic days of January 1799 tell much about the social fragmentation of late eighteenth century Neapolitan society. In December 1798, on getting the news of the poor military actions at the Northern border, the court had moved to Palermo, in Sicily. At this point the ancient aristocracy claimed its own right to rule the town in the absence of the king, refusing to recognize the authority of any royal delegate. Giving new life to medieval institutions, representatives of the families met in their own parliament (*i sedili*), which in the last century had been reduced to little more than a harmless political curiosity. They elected Antonio Minutolo Prince of

Canosa, one the most conservative elements of the group, to be sent to treat with the French in the name of "the Town of Naples". Little wonder that Canosa, at the return of the Bourbon, was charged with conspiracy to establish an aristocratic republic. Canosa found himself on the same side as the "low people" (*popolo basso*), who were planning to resist the devilish and anti-Christian French. Canosa met General Championnet, and offered him a sum of money not to enter the town; Lauberg, who was present as Championnet's councillor, insisted that the General refuse the offer[151].

At the end of January 1799, Lauberg was elected President of the Provisional Government of the Republic of Naples. At his side were the comrades of exile and those just freed from the fortresses. Vincenzo de Filippis was a member of the government; Annibale Giordano was in the Military Commission; Nicola Pacifico was a captain in the Republican Guard; Mario Pagano was called to work on the constitution of the new republic. Almost everyone involved in the 1794 conspiracy can be found among the members of the various commissions or in the republican army, headed by some of Lauberg's colleagues at the Military Academy. The clergymen Giuseppe Cestari and his brother Gennaro, champions of Jansenism and anti-curialism in the 1780s, also played important roles. Giuseppe was in the commission for internal administration. Like Lauberg, he was a radical on the feudal question: he was for the abolition of feudalism without any from of compensation. He also ordered the suppression of many monasteries. Gennaro was in the Ecclesiastical Commission, whose goal was to prepare, together with other "Jacobin priests" a "catechism of morals" comprehensible to the people, to free it "from superstition and error". The catechism, clearly Jansenist in its orientation, made clear that "only under a democracy does man enjoy these rights [equality, freedom, property, safety], which had been given to him by the Creator, and taken away by tyranny"; that "the people are the true sovereign"; and that "Christ recommended democracy". In the last days of the republic, Gennaro ordered the confiscation of the ecclesiastical silverware in order to finance the Republican Army.

There is no need to delve into the political history of the five month life of the Neapolitan Republic, which is well known and not directly relevant to the present study. Time was too short to introduce any real change in the scientific life of the town. Remarkable was the law on the abolition of the feudal system, prepared by Giuseppe Cestari and Mario Pagano, one of the few to be actually approved[152]. Lauberg's political life as president was difficult: he had to mediate between officers of the French Directoire, willing simply to despoil the country, and local patriots who believed in the autonomy of the newborn republic. Being a hard-liner on the feudal question worsened his position. In April he was excluded from the new government, established with French approval. The most incredible stories ran in Naples in those days about Lauberg's alleged misconduct; old and new enemies were taking revenge. The "unfrocked priest" had thus to leave the country, after risking being lynched by the mob.

Meanwhile, the military situation was rapidly deteriorating. Cardinal Ruffo had been extremely successful in raising volunteers among Calabrian peasants to fight under the crossed insignia of the Holy Faith. From February 1799, thousands of armed peasants followed him, occupying one after another every republican town of the South-West. The bourgeois landowners and professionals who had planted trees of liberty in their own squares were victims of indiscriminate massacres and their properties were sacked. Notorious was the siege and sack of the wealthy town of Altamura, whose middleclasses had enthusiastically embraced the republican government. The social dynamics of the crusade against the republicans are complex and extremely interesting. Not only did Ruffo cleverly exploit the hatred of the impoverished peasants for the "Jacobin gentlemen"[153], but he also recruited different men to attack different objectives, making the best of secular rivalries between provincial towns. When the Holy Faith Army met the Russian and Turkish troops landed on the coast of Apulia the circling manoeuvre was completed, and the siege of the capital could begin. In the first days of May the French army retired Northwards, due to the victories of the Austro-Russians in the Po Valley. The only Republican Guard was now facing the allied troops and the Holy Faith Army. On the 5th of June, a state of emergency was proclaimed in Naples. On the 13th all those defending the Republic were at the Ponte della Maddalena, the southern gate of the town, where the attack had begun early in the morning. It was the day of Saint Anthony of Padua, patron saint of the Holy Faith Army. Around ten thousand Republican troops were facing seventy thousand attackers supported by Russian artillery and by the guns of a British naval squad. After a day of fighting, the attacking troops entered the town, joining the "low people" in the sack. A week later, the surviving Jacobins entrenched in the fortresses of the town were offered an armistice by the allied generals, and the possibility of reaching France safely. They were embarked, but Admiral Nelson, backed by the Bourbon and by his own government, argued that any word given to rebels against the king need not be kept. New special tribunals were created to try the "rebels", and about one hundred of them were executed in Piazza Mercato. Some of the people we met in our story lost their lives in these events. Giuseppe Cestari was killed in the fight at the Ponte della Maddalena; Mario Pagano was hanged, along with three men who declared themselves "mathematicians" when arrested: Vincenzo de Filippis, Nicola Fiorentino, and Nicola Pacifico. Ex-aristocrats, such as Lauberg's student Ettore Carafa Count of Ruvo were beheaded, in respect of their status. Annibale Giordano was sent to a fortress, waiting to be executed (but he managed to escape his fate and to settle in France, where he became an engineer). Gennaro Cestari was exiled. Many managed to leave the country in the confusion of those days, and to continue their political battle in France and in Northern Italy.

3.10 Summary

Since the mid-century part of the Neapolitan intelligentsia actively promoted the study of the "useful" sciences in order to make sense of the Southern natural and social reality. The "reformers" referred to a set of cultural resources which included British empiricism, French sensationalism, and the new "analytic spirit" of the French *Encyclopédie*. Mathematical sciences were crucial in the plans of the reformers, who aimed to reproduce the certainty of mathematics in political and social matters. Yet, for specific historical contingencies, they could only rely on a very elementary level of mathematical teaching. The military academies absorbed the few mathematicians whose interests covered the recent development of analysis, and turned them into textbook writers. Collaboration between the enlightened Bourbon monarchy and the reformers became intense in the 1780s, when many of them entered the ranks of the administration. This was the decade of reformist minister Domenico Caracciolo, who threatened the privileges of the Church and of the feudatories as had never been done before. At the same time, he tried to modernize Neapolitan mathematics (he contacted Lagrange and, as we will see, he criticized anti-analytic mathematicians). This was also the decade of the successes of Jansenist clergy against the temporal pretensions of the Roman Catholic Church, which we have referred to by means of the activity of the brothers Cestari.

Around the mid-eighties it was becoming clear to many that the monarchy had neither the power nor the will seriously to reform the feudal-communal setting of the kingdom. The foundation of the anti-despotic lodge of the *Illuminati* (1786) is emblematic of this new trend in Neapolitan reformism. I have claimed that the battle of reformers can be best understood by interpreting it as grounded in a new structure of knowledge. This was characterized by:

1) an epistemological shift which excluded religious knowledge from the realm of legitimate knowledge, confining it to that of personal consciousness. This move was possible because sensation and natural reason were taken as the only reliable sources of knowledge;

2) the sensationalistic shift in epistemology justified in turn a methodological unification of the natural sciences and the moral sciences. In principle, the same criteria must be followed when investigating the laws of nature, the moral laws, and the laws of society.

At the turn of the 1790s masonic lodges, crucial centres of elaboration of reformist thought, were gradually transformed into Jacobin clubs. The ideology of the new conspiratorial organization was inspired by French Jacobinism, but the themes in focus were essentially those of the previous reformism; indeed many reformers turned themselves into Jacobins. Neapolitan Jacobinism was pursuing the objectives of the reformers, all of them related to the abolition of the feudal-communal system of land and of its economic and juridical implications. Little wonder that in support of the 1799 Jacobin Republic we find those provincial and urban middle-class groups who had asked for reforms during the 1780s, while the "low people" were to march under the standards of the Holy Faith. The socio-political thought (and action) of Neapolitan Jacobinism was imbued with the "spirit of analysis", which pervaded the mathematical sciences and all other forms of knowledge. Unnoticed by political historians, almost every single noteworthy figure in Neapolitan Jacobinism had some mathematical —indeed analytic—

training (at the private academy of Lauberg and Giordano, at the Military Academy, or abroad). A basic understanding of the working of the analytic method in mathematics was, I maintain, an essential part of their being Jacobins, as was republicanism and religious indifference. Far from being a useful "cover", as argued by other students of Neapolitan Jacobinism, the academy of Lauberg and Giordano is a key-point in understanding the nature of the movement. Here their specific social goals shaped the new scientific knowledge which in turn was to legitimize the immediate political and revolutionary action. One and the same way of thinking —or savoir-faire— pervaded their social theories, their organizing structure (the Society grouping the Jacobin clubs), their theory of knowledge, and their problem-solving methods in mathematics. This was the analytic savoir-faire, something that everyone could learn simply by looking at his own mind working "naturally". Analyzing phenomena in their elementary constituents, and then observing the natural relations among these constituents and the necessary order which connect them to each other. This was the true method in mathematics, as everywhere else in the realm of knowledge.

The supposed "neutrality" of science has prevented historians from recognizing in the regenerated natural and mathematical sciences of the Jacobins the print of their social and political aspirations[154]. The image of "nature", the "natural way of reasoning" and the "scientific knowledge" on which they based their own political system are social productions whose nature is essentially connected with the demand for overcoming the feudal-communal system of land. As in the case of the reformers, the administration of the state and the entrepreneurial activities of private individuals (the *industrianti*) are detached from any metaphysical consideration. It was precisely on a metaphysical system such as that ridiculed by Cestari, that the feudal jurisdiction and legislation were grounded. The de-legitimization of this kind of scholastic metaphysical knowledge (*à la* Wolff), the shift of religious knowledge "from the mind to the heart", and the resulting new autonomy of the moral and natural sciences —which are "naturalized" and re-organized in a new analytic structure— were the indispensable cultural resources to support the social critique of the feudal-communal system.

Notes to chapter three

[1] Harry Woolf (ed.), *The Analytic Spirit. Essays in the History of Science in Honor of Henry Guerlac* (Ithaca: Cornell U.P., 1981).
[2]Quoted in Thomas Hankins, *Science and the Enlightenment* (Cambridge: Cambridge U.P., 1985) p.21.
[3] For example, if we consider the so-called "chemical revolution" (1770s-1780s), we can remark that Lavoisier and the members of his emerging school had all been well trained in mathematics, and that they were unified "by a common spirit of inquiry inspired to the rigor and precision of mathematics, and by a commitment to extend such an approach systematically to areas of experimental physics, including chemistry" (Carleton Perrin, "The Triumph of the Antiphlogistians", in Woolf, *The Analytic Spirit*, p.42).
[4] See the *Discours préliminaire* and the final table. A recent English translation is Jean d'Alembert, *Preliminary Discourse to the Encyclopedia of Diderot*, edited by Richard Schwab (Chicago: Chicago U.P., 1995).
[5] Eric Brian, *La mesure de l'Etat. Administrateurs et géomèters au XVIII siècle* (Paris: Albin Michel, 1994).
[6] Brian, *La mesure de l'Etat*, p.45.
[7] From a Condorcet's manuscript, quoted in Brian, *La mesure de l'Etat*, p.47.
[8] Michel Paty, "Rapports des mathématiques et de la physique chez d'Alembert", *Dix-huitième Siècle*, 1984, 16, p.79.
[9] See, for instance, Jean-Étienne Montucla, *Histoire des mathématiques* (Paris: 1758) vol 1, p.374.
[10] Quoted in Brian, *La mesure de l'Etat*, p.53.
[11] Quoted in Brian, *La mesure de l'Etat*, p.47.
[12] Alexandre Koyré, *Études d'histoire de la pensée philosophique* (Paris: Gallimard, 1971) p.116.
[13] See the example provided in Brian, *La mesure de L'Etat*, p.68.
[14] See Robert Darnton, *Business of the Enlightenment: Publishling History of the "Encyclopédie", 1775-1800* (Cambridge, Mass.: Harvard U.P., 1987).
[15] *Encyclopédie*, vol. 6 (Paris: 1756) p.136.
[16] *Encyclopédie*, vol.1 (Paris: 1751) p.498.
[17] See Mary Douglas, *Purity and Danger: An Analysis of the Concepts of Pollution and Taboo* (London: Routledge, 1988).
[18] For a comparative study, see Luigi Pepe, "Sulla trattatistica del calcolo infinitesimale in Italia nel secolo XVIII", in Grugnetti-Montaldo, *La storia delle matematiche in Italia*, pp.145-227.
[19] Giuseppe Marzucco, *Riflessioni intorno alla quadratura del cerchio e delle curve, ove per comodo della gioventù si spiegano brevemente ancora li principi del calcolo Differenziale ed Integrale* (Naples: 1767).
[20] Girolamo Saladini, *Compendio di analisi* (Naples: 1790).
[21] Vincenzo Porto (?-1800). An engineer, he wrote a treatise on steam boats (manuscript), and directed the School of the Navy. See Amodeo, *Vita matematica napoletana*, vol.2, p.362.
[22] Vito Caravelli and Vincenzo Porto, *Trattato del calcolo Differenziale di Vito Caravelli e del calcolo Integrale di Vincenzo Porto per uso del regale Collegio Militare* (Naples: 1786).
[23]The phenomenon of the *studi privati* (private studios) was typical of the educational system of the Kingdom of Naples during the 18th and 19th century. Given the conservatism of the university curricula, students willing to study contemporary authors (both in the natural sciences and in the humanities) needed to attend such private schools. Quite often, university professors also ran private studios. These schools were relatively tolerated by the authorities, except in particularly critical situations, such as the years of the Jacobin plots (1794-1799). On the educational system in Naples around 1800 see Alfredo Zazo, *L'istruzione pubblica e privata nel napoletano, 1767-1860* (Città di Castello: 1927).
[24] Annibale Giordano, "Considerazioni sintetiche sopra un celebre problema piano e risoluzione di alquanti problemi affini", *Memorie di matematica e fisica della Società Italiana delle Scienze, detta dei XL*, 1786, 4:4-17.
[25] Tommaso Pedio, *Massoni e giacobini nel Regno di Napoli. Emmanuele de Deo e la congiura del 1794* (Bari: Levante, 1986) p.16.
[26] Pedio, *Massoni e giacobini*, p.15.

[27] Benedetto Croce, "Carlo Lauberg", in *Vite di avventure di fede e di passione* (Bari: 1936) p.363.
[28] See Michael Kennedy, *The Jacobin Club of Marseille, 1790-1794* (Ithaca: Cornell U.P., 1993).
[29] Antonio Jerocades, *La lira focense* (Naples: 1789).
[30] Pedio, *Massoni e giacobini*, p.72.
[31] Nicola Nicolini, *La spedizione punitiva del Latouche-Tréville, 16 dicembre 1792* (Florence: 1939) pp.90-91.
[32] Pedio, *Massoni e giacobini*, p.80.
[33] Ibidem, p.84.
[34] Armando Saitta, "La questione del giacobinismo italiano", *Critica Storica*, 1965, 4, p.204.
[35] Pedio, *Massoni e giacobini*, p.86.
[36] Quoted in Francesco Scandone, "Giacobini e sanfedisti nell'Irpinia", *Samnium*, 1928, 1, p.49.
[37] See Nicolini, *La spedizione punitiva*, p.105.
[38] See Tommaso Pedio, *Giacobini e sanfedisti nell'Italia meridionale* (Bari: Levante, 1974) vol.1, p.43; p.63; p.141; and vol.2, p.702.
[39] On the episode see Nicolini, *La spedizione punitiva del Latouche-Tréville*.
[40] Croce, "Carlo Lauberg", p.364.
[41] Giarrizzo, *Massoneria e illuminismo*, p.393.
[42] See Pedio, *Massoni e giacobini*, p.96.
[43] Ibidem, pp.97-98.
[44] Ibidem, p.99.
[45] Barruel, *Mémoires*, vol.2, pp.418-419.
[46] Pedio, *Massoni e giacobini*, p.102.
[47] Ibidem, p.117.
[48] See Croce, "Carlo Lauberg", p.372.
[49] Pedio, *Massoni e giacobini*, p.318.
[50] Netti fled the country in 1794. In 1799 he was back to support the Jacobin republic, and in 1820 he was a member of the constitutional parlament. He published on physics, economics and agriculture. See Pedio, *Massoni e giacobini*, p.101.
[51] Ibidem, p.439.
[52] Ibidem, p.482.
[53] Ibidem, p.504.
[54] On the "triennio giacobino" see Renzo de Felice, *Il triennio giacobino in Italia, 1796-1799* (Rome: Bonacci, 1990) which also contains an essay on the historiography of Italian Jacobinism.
[55] Renato Soriga, *Le società segrete, l'emigrazione politica e i primi moti per l'indipendenza* (Modena: 1942) p.153.
[56] See Croce, "Carlo Lauberg", p.371.
[57] Ibidem, p.378.
[58] Carlo Lauberg, "Progressi dello spirito umano nell'Italia", *Il Monitore Italiano*, 2, 22 January 1798, p.8; and 5, 28 January 1798, pp.19-20.
[59] Quoted in Soriga, *Le società segrete*, p.167.
[60] Ibidem, p.168.
[61] Carlo Lauberg, "Economia pubblica sull'alto prezzo delle cose", *Il Monitore Italiano*, 12, 11 February 1798.
[62] Carlo Lauberg, "Discorso su la resa di Mantova", *Giornale de' Patrioti d'Italia*, 15, 21 February 1797.
[63] The letter was published in *Giornale de' Patrioti d'Italia*, 27-28 March 1797.
[64] *Giornale de' Patrioti d'Italia*, 24, 14 March 1797.
[65] Croce, "Carlo Lauberg", p.385.
[66] *Il circolo costituzionale di Milano*, 8 March 1798, 12:178-179.
[67] See, for instance, the authoritative judgements by Benedetto Croce, to whom the scientific study was "almost a pretext" (Croce, "Carlo Lauberg", p.362); and Tommaso Pedio, according to whom "chemistry and mathematics were a mere pretext for both maestro and pupils" (Pedio, *Massoni e giacobini*, p.15).

[68] Michele de Tommaso and Ascanio Orsi, *Catechismo su i diritti dell'uomo composto dai cittadini Tomaso ed Orsi, patrioti napoletani rifuggiti* (Forte d'Ercole: n.d. [1794]).
[69] Quoted in Battaglini, *La Repubblica Napoletana*, pp.61-62.
[70] Ibidem, pp.67-71.
[71] For biographical information on Lauberg see Croce, "Carlo Lauberg".
[72] Boccanera was to be exiled because of his involvement in the 1799 Jacobin Republic. A well-known surgeon, he returned in Naples during the French period, and he began to lecture in the RUN in 1806. See Alfredo Zazo, "L'ultimo periodo borbonico", in *Storia dell'università di Napoli* (Bologna: Il Mulino, 1993) p.547.
[73] Carlo Lauberg, *Analisi chimico-fisica sulle proprietà de' quattro principali agenti della natura, seguita da un saggio sulle principali funzioni degli esseri organizzati* (Naples: 1788).
[74]Carlo Lauberg, *Riflessioni sulle operazioni dell'umano intendimento* (Naples: n.d. [between 1786 and 1789]).
[75] Self-interest is, according to Helvétius, reducible to "sensibilité physique", the primary human faculty, which consist in the capacity of registering sense impressions arising from the external world. *Sensibilité physique* is the exclusive source of all ideas, judments, memories and emotions. As a consequence, it is futile to try to inculcate social virtues by mere moralizing, and by condemning pleasure: moral improvement and happiness of mankind can result only from the establishment of a new system of education based on the gratification of *sensibilité physique*. In *De l'homme* (1773), Helvétius explicitly described Christianity and the feudal structure of society as the two main obstacles to the happiness of mankind. See Claude-Adrien Helvétius, *Oeuvres complètes*, 3 vols. (Paris: 1818). See also the recent editions of *De l'homme*, 2 vols. (Paris: Arthème Fayard, 1989); and *De l'esprit* (Paris: Arthème Fayard, 1988; orig.ed. 1758). Lauberg translated and edited *L'Esprit* in Milan, in 1797.
[76] François Pluquet, *Examen du fatalisme ou exposition et réfutation des différents sustèmes de fatalisme qui ont paratgé les philosophes sur l'origine du monde, sur la nature de l'âme et sur les prinncipes des actions humaines*, 3 vols. (Paris: 1757). The Neapolitan edition by Lauberg was entitled *Esame del fatalismo, osia esposizione e confutazione dei diversi siustemi di fatalismo che han divisi i Filosofi sull'origine del mondo, sulla natura dell'Anima, e sul Principio della Azioni umane*, 3 vols, (Naples: 1791). Abbé Pluquet was professor of moral theology and, later, of history at the Collège de France from 1766 to 1782. In *La sociabilité*, 2 vols. (Paris: 1767), Pluquet argued for the natural inclination of human beings towards social life and a virtuos behaviour. He inclined for Jansenist positions, and was a friend of the *philosophes*, particularly Fontenelle, Montesquieu and Helvétius. Note that these relations are denied by the compilators of the *Dictionnaire de Théologie Catholique*, edited by A.Vacant and E.Mangenot (Paris: 1903-1950), sub voce. My impression is that they accept the "revised" description of Pluquet's life and work which was provided during the Restoration by his nephew, Frédéric Pluquet (1781-1834), an intransigent Catholic (see his article in *L'Ami de la religion*, 16 June 1818).
[77] Lauberg, *Esame del fatalismo*, vol.1, p.48.
[78] Ibidem, vol.2, p.271.
[79] Ibidem, vol.1, p.192. Lauberg described Bruno as "a man of great and fervid imagination, thus impatient and subject to errors; but who had great views, and who was author of many systems, which were later rescued by many great men". Lauberg also referred to a dissertation on Bruno written by his friend Gaspare Selvaggi (1763-1856). Selvaggi was himself a conspirator of 1794; and remained politically active until 1848, when he was registered among the members of the provisional commission for the reform of education, established by the revolutionary government (see Zazo, "L'ultimo periodo borbonico", in *Storia dell'Università di Napoli*, p.494). The thought of Bruno had enjoyed a certain fortune among Neapolitan freemasons since the mid-century, and Brunian references are in the works of the principal Neapolitan reformers, such as Filangieri and Pagano. On the fortune of Bruno among the authors of the so-called "radical Enlightenment" see Jacob, *The Radical Enlightenment*, pp.35-40.
[80] Lauberg, *Esame del fatalismo*, vol.3, p.63.

[81] See "Laubert, Jean-Charles", in *Nouvelle biographie générale*, vol.29 (Paris: 1859).
[82] Carlo Lauberg, *Memoria sull'unità dei principi della meccanica* (Naples: n.d. [1789]). Quotations are from the unpaginated dedication.
[83] Ibidem, p.4.
[84] Croce, "Carlo Lauberg", p.357.
[85] Annibale Giordano and Carlo Lauberg, *Principii analitici delle matematiche* (Naples: 1792).
[86] Giordano - Lauberg, *Principi analitici*, pp. 1-2.
[87] On this point, the link between Neapolitan Jacobinism and Neapolitan Enligthment is evident: Genovesi's aim was, indeed, that of identifying the true "laws of politics and economics". In his words: "[p]olitics, as economics, has its own certain and eternal principles: thus, it has its own certain theorems and its own problems" (Antonio Genovesi, *Logica per gli giovinetti*, in Genovesi, *Scritti*, p.232). On the basis of these alleged laws, Genovesi had been able to criticize the feudal social setting of the kingdom, as well as its juridical system, which openly favoured aristocracy in its quarrels with the local communities. The extreme complexity of the old laws, he showed, was in fact functional to mantain a *status quo* which originated from an illegal action, namely the acquisition of feudal rights. Nevertheless, if in Genovesi the creation of the new sciences of economics, politics and law was to be accomplished in a reformist perspective, in Lauberg and Giordano the discovery of the true, simple and analytic principles of these sciences, is a rational justification for the revolutionary action. In the metaphor of Francesco Lomonaco, a Jacobin who defended Naples in 1799: "[t]he great tree of the sciences [...], will form leafy branches, which will provide a restful shadow for a humiliated mankind" (Francesco Lomonaco, *Rapporto al cittadino Carnot* (1800), in Cuoco, *Saggio sulla rivoluzione napoletana del 1799*, p.288).
[88] On de Filippis see Raffaele Mazzei, "Un calabrese del '700, patriota e scienziato: Vincenzo de Filippis", *Archivio Storico di Calabria e Lucania*, 1976, 48:161-199.
[89] Aracri had been teaching in Naples in 1777-79, and at that time he frequented Filangieri, Pagano and Jerocadès. From 1779 he taught philosophy and mathematics at the Royal College of Catanzaro, publishing a number of didactical texts of logic, geometry, algebra, physics and ethics (see list of works in *Dizionario biografico degli italiani*, sub voce). The publication of his *Elementi del diritto naturale* (Naples: 1787) caused the critical reaction of the Church, which attacked Aracri through the clergyman Francesco Spadea. After an exchange of publications with Spadea, Aracri was called to Rome, to defend himself from the accusation of heterodoxy. Evidently his explanation was not too convincing, because the book was inserted in *Index*, at that time directed by the intransigent Cardinal Gerdil. Aracri retired from teaching, but soon after he published *Dell'amor proprio* (Naples: 1789), a treatise of hedonist ethic in the best tradition of Neapolitan radical thought. In 1799 Aracri is one of the many Jacobin priests who support the revolution: in his sermons he praised liberty and asked for the abolition of feudal taxation over peasants. He was back to teaching in the French period, when his *Elementi* were reprinted (1808).
[90] On Pacifico see Vito Capialbi, *Nuovi motivi comprovanti la dualità della mesma e della medama [...] si uniscono le notizie dell'abate Nicola Maria Pacifico* (Naples: 1849).
[91] On the Neapolitan seminar see the articles in *Campania Sacra*, 1984-1985, 15-17.
[92] Federico Napoli-Signorelli, "Discorso istorico preliminare", in *Atti della Reale Accademia di Scienze e Belle-Lettere dalla fondazione sino all'anno MDCCLXXXVII*, 1788, 1:xxv-xxvi.
[93] Ibidem, p.xxxii.
[94] Capialbi, *Nuovi motivi*, p.58.
[95] Nicola Fiorentino, *Saggio sulle quantità infinitesime e sulle forze vive e morte* (Naples: n.d.). The reference to Pacifico is at p.16.
[96] Fiorentino, *Saggio*, p.51.
[97] Nicola Fiorentino, *Riflessioni sul Regno di Napoli, in cui si tratta degli Studj, de' Tribunali, delle Arti, del Commercio, de' Tributi, dell'Agricoltura, Pastorizia, Popolazione, e di altro* (Naples: 1794).
[98] Fiorentino, *Riflessioni*, p.ix.
[99] Ibidem, p.xi.
[100] Ibidem, p.163.

[101] Ibidem, p.17.
[102] Ibidem, p.19.
[103] Ibidem, p.181.
[104] Ibidem, pp.56-57.
[105] Ibidem, p.122.
[106] Ibidem, p.124.
[107] Ibidem, p.22.
[108] See Albert Mathiez, *La Théophilantropie et le culte décadaire, 1796-1801* (Paris: 1904).
[109] On Ranza, who directed the Milanese newspaper *L'amico del popolo italiano*, see Giovanni Roberti, *Il cittadino Ranza. Ricerche documentate* (Turin: 1890).
[110] On the connections between Jacobinism and Jansenism in Naples during the 1799 revolutionary government see Domenico Ambrasi, "Il clero a Napoli nel '99 tra rivoluzione e restaurazione", *Campania sacra*, 1991, 22:52-81. On the various aspects of Catholicism in Naples during the eighteenth century see Romeo de Maio, *Religiosità a Napoli, 1656-1799* (Naples: Edizioni scientifiche italiane, 1997).
[111] Croce, "Carlo Lauberg", pp.387-390.
[112] *Il circolo costituzionale di Milano*, 1798, pp.42-43.
[113] Ibidem, p.44.
[114] Ibidem, pp.51-57.
[115] The episode is in Francesco Cusani, *Storia di Milano dall'origine ai giorni nostri e cenni storico-statistici sulle città e provincie lombarde*, vol.5 (Milan: 1867) pp.203-204.
[116] *Il circolo costituzionale*, pp.88-91.
[117] Girolamo Bocalosi, *Istituzioni democratiche per la rigenerazione del popolo italiano* (Milan: 1798). The Tuscan Bocalosi (whose dates of birth and death are unknown), was a radical author active between the mid-1780s and 1799. Denounced a s a freemason in 1792 in Verona, he was decribed by the authorities as "a man of remarkable education, but of exalted mind", and "too adherent to the new philosophy". He was in Milan between 1797 and 1798, where he frequented Lauberg, Netti, and the other Neapolitan Jacobins. Here he also reprinted his previous work *Dell'educazione democratica da darsi al popolo italiano* (1797), one of the most radical pedagogical productions of Italian Jacobinism. Paul Hazard defined it "le traité d'éducation démocratique le pèlus réflechi et le plus complet" (see Paul Hazard, *La Révolution Française et les lettres italiennes* (Paris: 1910) pp.100-102. It has been reprinted in Delio Cantimori and Renzo de Felice, *Giacobini italiani*, vol.2 (Bari: Laterza, 1964).
[118] On this kind of irreligious literature see Richard Popkin and Arjo Vanderjagt (eds.), *Scepticism and Irreligion in the Seventeenth and Eighteenth Centuries* (Leiden: Brill, 1993). On the notorious *Traité des Trois Imposteurs* see Silvia Berti, François-Charles Daubert and Richard Popkin (eds.), *Heterodoxy, Spinozism and Free Thought in Early Eighteenth-Century Europe: Studies on the Traité des Trois Imposteurs* (Dordrecht: Kluwer, 1996).
[119] Lauberg's note in Helvétius, *Lo spirito*, vol.1 (Milan: 1797) p.151.
[120] *Storia dello stabilimento della religione cristiana* (Pavia: 1797). The author was probably Massa himself (see Soriga, *Le società segrete*, p.239).
[121] Idem.
[122] Gennaro Cestari, *Lo spirito della giurisdizione ecclesiastica sulle consagrazioni de' vescovi* (Naples: 1788).
[123] Carlo de Marco (1711-1804), had been Minister of Ecclesiastic Affairs from 1759. In spite of being a devout Catholic, he defended a secularized conception of the state, and openly supported Neapolitan Jansenism. In 1769 he created the chair of History of Councils at the RUN, on suggestiuon of Jansenist clergmen. He was also Minister of Justice, and in this field he fought the particular jurisdictions of the barons and of the Church, strengthening the authority of the state. He was a friend of Genovesi and Filangieri, and of Minister Caracciolo. In 1791, with Neapolitan policy suddenly changing direction, de Marco was dismissed from both ministries.
[124] One year later, his brother Giuseppe, he himself a clergyman of rigorous Jansenist convictions, published an equally provocative *Dimostrazione della falsità dei diritti dellla Santa Sede sulla chiesa delle Due Sicilie* (Naples: 1789), on explicit request of the Crown. He attacked

the feudal pretensions of Rome and the "mundanity" of the Roman curia in the name of the purity and poverty of the original Christianity. In 1788 he had already criticized the devotion of the Sacred Heart of Jesus, defended by Jesuits through the century.

125 Lauberg to the people of Brescia: "your regenerated morals are worthy of the most virtuous republicans" (Carlo Lauberg, "Un libero italiano al popolo bresciano", *Giornale de' Patrioti d'Italia*, 39, 18 April 1797).

126 Gennaro Cestari, *Tentativo sulla rigenerazione delle scienze* (Milan: 1803).

127 Ibidem, pp.8-9.

128 Ibidem, p.10.

129 Ibidem, p.15.

130 Ibidem, p.19.

131 Ibidem, pp.20-21.

132 Ibidem, p.23.

133 Ibidem, p.24.

134 Ibidem, p.104.

135 Ibidem, p.110.

136 This topic was clearly linked to the Jacobin campaign against "pure sciences" and speculative knowledge, in favor of a conception of science as knowledge useful to human society. "True scientific knowledge" is the product of the contemporaneous action of different faculties; it does not derive exclusively from the intellectual ones. In the Jacobin thought, the re-evaluation of the epistemological role of passions went together with their crucial role in grounding the hedonist morals, and the science of society.

137 Cestari, *Tentativo*, p.136.

138 Ibidem, p.152. The devaluation of the faculty of memory yields the elimination of history as a significant branch of knowledge. Interesting, for instance, is Cestari's treatment of natural history, which he describes not as a "history of nature" (the definition of the *Encyclopédie*), but as the basis of physics. Significanlty, Cestari rejected the classification of arts, crafts and manufacture as branches of natural history, and described them as part of experimental physics which, in turn, is derived from reason rather than from memory.

139 Cestari, *Tentativo*, p.141.

140 Ibidem, pp.142-143.

141 Ibidem, p.179. D'Alembert claimed that the objects of the sciences are the notion of space, time, spirit ad matter.

142 Cestari, *Tentativo*, pp.185-186.

143 Ibidem, p.187.

144 Ibidem, p.195. Cestari's remarks on the misleading dualism of matter and spirit are useful to make sense of the refusal of Jacobin thinkers to embrace materialism (we described the cases of Lauberg and Delfico). This point has been misunderstood by historians of philosophy (particularly by those more idealistically inclined), who accuses the Jacobins of being incoherent for not assuming a materialist position (see Gentile on Delfico, for instance). What is judged as an incongruity and a theoretical weakness of their thought, can instead be seen as a move out of the conceptual dichotomy of matter and spirit.

145 Cestari, *Tentativo*, pp.202-203.

146 Ibidem, pp.204-205.

147 Cestari explains how, through the dichotomy matter/spirit, metaphysics "extended its jurisdiction on the science of man and of nature" (see pp.208-213). Note also the critique of the Wolffian conception of methaphysics, and of Wolff's scholastic system of knowledge, which Cestari correctly described as essentially circular (see pp.223-229).

148 See pp.244-249.

149 Cestari, *Tentativo*, pp.250-253.

150 Ibidem, pp.267-273.

151 See Croce, "Carlo Lauberg"p.404.

152 On the 1799 anti-feudal law see Giuseppe Galasso, *La filosofia in soccorso de' governi. La cultura napoletana del Settecento* (Naples: 1989) pp.633-660.

[153] The identification of the "Jacobins" with the emerging class of bourgeois landowners is evident in the popular songs of 1799 collected by Benedetto Croce, "Canti politici del popolo napoletano", in Croce, *Curiosità storiche* (Naples: 1921).

[154] In fact, Charles Gillispie has described the features of the "Jacobin philosophy of science" in revolutionary France. His results are strikingly different from ours, though. Reasons for such a difference lie first of all in Gillispie's theoretical assumptions about the nature of scientific knowledge: "good" science provides neutral descriptions of reality; Jacobins have attacked and distorted science to serve their totalitarian purposes (not differently from Marxists). On the historical level, the main difference from the present study consists in Gillispie's argument for the anti-mathematical and anti-systematic character of the Jacobin image of science. This argument is based on a debatable interpretation of the Jacobin urge for the social utility of science which, I suggest, should be understood as an anti-scholastic critique of the abstract and purely intellectual sciences, rather than of "modern science" *tout court*. See Charles Gillispie, "The *Encyclopédie* and the Jacobin Philosophy of Science: A Study in Ideas and Consequences" (1959), in Marshall Clagett (ed.), *Critical Problems in the History of Science* (Madison: Wisconsin U.P., 1962); and Charles Gillispie, *The Edge of Objectivity: An Essay in the History of Scientific Ideas* (Princeton: Princeton U.P., 1960) chapter five: "Science and the Enlightenment", pp.151-201.

Chapter Four

The Knowledge of Reaction: Religion and Society

At the beginning of the 1799 revolution, Fergola had left Naples for the quiet hill of Capodimonte, a few miles east of the town. "Not agreeing with the new political aspirations, he remained forgotten and isolated during the whole revolutionary epic", one biographer wrote[1]. The see of his school of geometry at the *Collegio del Salvatore* (College of the Savior) was transformed, under the republic, into a military hospital. When Fergola returned to Naples, in Autumn 1799, he found himself charged with the re-organization of scientific and mathematical education in the restored kingdom. This, and the next chapter, are devoted precisely to investigating the reasons for the predominance of the synthetic approach to mathematics around 1800. I shall argue that Fergola's approach —like Lauberg's— was shaped by specific cultural and social goals, and that the fortune of his school cannot be fully assessed without considering the socio-political process of the "return to order". Thus, as an introduction to the analysis of Fergola's work, we shall look at the salient aspects of the response of Catholic culture to both the external attacks of eighteenth century philosophers and to the internal criticisms of reformers such as the Jansenists. It is as part of this general reaction of Catholic culture against the "culture of the century" that Fergola's approach to science and mathematics is best understood.

King Ferdinando IV of Naples, Restorer of the True Faith (1799)

4.1 Early Reactionary Catholicism

During the second half of the eighteenth century the Roman Catholic Church assumed a position of intransigent reaction against the culture "of the century"[2]. The rejection of the modern vision of the world was evident since the beginning of the pontificate of Clemens XIII, in 1758. The fight against the *philosophes*, according to the Pontiff, had to be the common aim of both the Church and the monarchies. In an early version of the throne and altar argument, the Roman curia had identified the roots of the political culture of the *philosophes* in the corruption of fundamental moral and religious values. This corruption, which stemmed from the original rebellion of the Protestant Reform, would eventually generate a crisis of European culture and society. From this perspective, the only possibility for Christian society to escape self-destruction was to return to a pseudo-medieval theocratic structure, where the Pontiff was charged with the crucial, temporal role of mediator between the monarchies and the peoples.

The short pontificate of the moderate Clemens XIV saw a limitation of the temporal pretensions of the Church, and the abolition of the Society of Jesus (1773), following the intense anti-Jesuit campaign of most European monarchies. The reaction of the conservative clergy was marked by a flourishing of anti-modern publications. Meanwhile, an unprecedented series of supernatural phenomena, such as prophetic signs and mystic visions, was registered all over Europe. These were interpreted by conservative clergy as announcing an incoming divine intervention to punish the impious actions of the Pontiff and of the "enlightened" monarchies, which were fighting their own battle to strip the Church of its traditional social functions. The accounts of these super-natural phenomena, the renewal of superstitious practices and cults by intransigent clergy, and the activity of propaganda performed by the semi-clandestine network of the "Christian Friendships" (*Amicizie Cristiane*)[3], where many ex-Jesuits were continuing their anti-modern campaign, were to be the sources of Reactionary Catholicism. This was a theological, cultural and political movement which enjoyed a remarkable success in France, Italy and Germany between 1790 and 1830.

The condemnation of "modern philosophy" is clearly stated in the encyclical *Inscrutabile divinae sapientiae* (1775) by Pope Pius VI who openly supported the anti-modern trend. The encyclical saw in the spread of atheism the main cause for the dissolution of social structure, a thesis which was essential to Reactionary Catholic thought. In the 1780s, the role of the Church in maintaining social stability was stressed in the articles of *The Ecclesiastical Journal of Rome*. But the Church was not a monolithic bloc. The reactionary trend, supported by the Pontiff and the curia, was contested by internal movements aiming to renew the structure of the Church and to re-define its role inside society. Jansenism was the most influential among these movements, its rigorous moral connotations providing strong theological support to national governments in their fight against the economic and cultural pretensions of the Roman Church. The crisis of the temporal power of the Church was taken by Jansenist ecclesiastics as an opportunity to return to the original spirit of the evangelic message, and to the original poverty of the Church. This internal debate and the very possibility of reforming the Church from the inside came suddenly to an end with the anti-Christian policy of the newborn French Republic. In fact, the 1790s saw the elaboration of a well structured response by the Church to the encyclopedic system of thought of the *philosophes*, which was taken as directly responsible for the "great insurrection", the French Revolution. Catholic authors dealt with two main themes: on the one hand they provided an idealized representation of the political life of the Middle Ages (when the authority of the Pontiff guaranteed the stability of the social setting of the *res publica christiana*); on the other, they attacked the culture of the eighteenth century. Jansenists, freemasons, *philosophes*, and Jacobins were, from this perspective, the authors of a single, enormous conspiracy against the Church and against society[4].

In 1796, the passage of the French Army through the countryside of Northern Italy was surrounded by a new series of disquieting miracles and terrible visions, as rural populations experienced the anti-religious policy of the new Republican and philo-French governments as dissolving those fundamental social links which had informed their life under the *ancien régime*. Between 1796 and 1799, in the "regenerated" towns, religious reformist movements experimented with new forms of religious life, under the protection of the Republican governments. We have seen some of this ferment when dealing with Lauberg's participation in the regeneration of Northern Italian towns. Since 1799, with Napoleon's normalization of the revolution and the fall of the Jacobin republics in Italy, the debate inside the Catholic Church was restricted to that between the pragmatic supporters of a

Napoleonic "Neo-Costantinism" and the ultra-reactionary elements grouped around the medieval theocratic project. These, who had firstly operated in the Christian Friendships, introduced into Italy the themes of French Traditionalism. In the same years, the number and relevance of the "popular missions" increased. The missions, initially organized and directed by the Jesuits, had the goal of re-grouping people around the parishes and, more specifically, of diffusing a kind of baroque religious devotion which was at odds with Jansenist rigor and individualism. The cults of the Sacred Heart of Jesus (symbol of the Vandean Counter-Revolution), of the Sacred Blood of Jesus, of the Virgin Mary, of the saints and of the holy images were supported and organized by the missions.

Among the books which contributed to the early elaboration of Catholic Reactionary thought, were the very popular *The Rights of Man* (1791) by Nicola Spedalieri (1740-1795)[5], and the *Theological-political Letters* (1794) by Pietro Tamburini[6]. They were the first consistent response of Catholic thought to the events of the French Revolution, and were written by two ecclesiastics. The first, published with the approval of the Roman curia, was an interesting attempt to combine a theocratic conception of power with the principle of popular sovereignty. Christianity is presented as the necessary foundation of society and the only defense against the excesses of a popular government. In fact, the "real" human rights which are clearly stated in the Gospel, have been suppressed by the French Revolution. Any attempt to built a society based on "natural" or deistic principles is doomed to failure. Atheism, religious reformism, Jansenism, the French Revolution, are deadly enemies to those who want to save the very possibility of a civil society. Spedalieri asks the monarchies to renounce their reformist policies (the regalist, anti-curial and anti-feudal trend of the eighteenth century), and to return to the Church its ancient privileges and its central position in social life. Otherwise, Spedalieri threatened, the Church could finalize its theocratic project with the support of the new democratic governments.

Tamburini's book was a reply to Spedalieri by a counter-revolutionary Jansenist. Spedalieri had denounced the dangerous, hidden alliance between regalist policy, Jansenist reformism and revolutionary ideas. In fact, during the 1790s, Italian sovereigns were abandoning the reformist policy supported by Jansenist clergymen to approach the reactionary position of the Roman Church. Tamburini tries to oppose this political re-orientation, by arguing that Jansenists cannot be confused with revolutionaries, because they recognize the divine origin of monarchic power. Reversing current criticisms, Tamburini claimed that the moral rigor of Jansenism turns the religious man into a faithful subject [7].

Another very interesting piece of information about the early diffusion of reactionary thought in Italy is provided by the 1789 essay "Some Thoughts on the French Revolution", by the democratic thinker Pietro Verri. Verri described the growing hostility expressed by the Italian upper classes towards the developments of the French Revolution. He observed that

> the more essential and concrete principles about government, about human rights, and about the nature of monarchy —principles so simple that they are norms among the savage tribes— are called, among us, metaphysical principles. [8]

This means that the accusation of "abstractness" and "artificiality", referring to the principles of the French Revolution, was already widespread in Italy. This argument was to be one of the central points of the theoretical elaboration of Reactionary Catholicism. Verri reported that part of the Italian intelligentsia was turning its initial enthusiasm for the Revolution into fear and hate for Jacobinism. The anti-religious policy of the French Republic, which resulted in the "civil constitution of the clergy" (1790), was certainly a crucial factor for the consolidation of the intransigent position inside the Church. Still, in the Italian states a minority of "Jacobin priests" remained active during the 1790s, preaching the "democratic message" of the Gospel; and a number of them, as we have seen, were to share the gallows with Neapolitan Jacobins.

Revolutionary ideas (which would later be re-elaborated into liberal positions) continued to be popular among important sectors of the Italian middle classes. The adoption of democratic and egalitarian ideas had been facilitated by the previous diffusion of the culture of Enlightenment in the Italian states. A crucial factor was the generalized crisis of the socio-economic structures of the ancient Italian states. A still economically powerful feudal aristocracy shared with the Church the ownership of the majority of land, and enjoyed a number of privileges such as tax exemptions and special jurisdictions. Economic crisis pushed these aristocratic landlords to increase the pressure on tenants and day-labourers, mainly by restoring forgotten medieval rights and enclosing (abusively) portions of the once-communal land. This form of "aristocratic reaction" was only increased by the new threatening competition of the active bourgeois landowners (recall the *industrianti* defended by Neapolitan reformers). They were very soon to constitute the backbone of the Italian landed middle class. Relations among these social groups were complex and continuously re-negotiated. So, for instance, bourgeois landowners and peasants were allied in the fight against feudal and ecclesiastical rights over land and production; bourgeois landowners and landed aristocracy were sharing among themselves the communal lands, they were contesting the communal rights of peasants, and applauded the suppression of landowning monasteries; landed aristocracy and peasants were defending the existence of the feudal-communal system of land, by which they were granted certain basic rights threatened by the new bourgeois model of "full ownership" of land. What is certain is that the old socio-political setting was inadequate for the new kind of society which was emerging during the second half of the century. The fact that in Italy we do not find revolutionary ideas before 1789 —but instead a number of reformist projects— can perhaps be linked to the predominance of landed bourgeoisie among the emerging classes.

The Italian Jacobin movement took shape in the 1790s, and it produced the short experience of the Jacobin republics (1796-1799). After the crucial break of 1799, the Italian middle classes were to express their moderate social and political aspirations in the forms of political and economic liberalism and of the clandestine patriotic movements, aiming to unify Italian states under a modern constitutional monarchy. When we look at the specific case of the Kingdom of Naples, we find that this general description of social conflict is in fact radicalized, due to the unusual power of Southern feudatories, to the remarkable influence of the Church, and to the extreme poverty of agricultural laborers. In short, in the Southern kingdom the feudal-communal system was much more an obstacle for landed bourgeoisie than in any other Italian state. One can thus expect that Naples was one of the main centers for the elaboration of reactionary thought, and indeed this was the case.

4.2 Religion and Society in French Traditionalism

Catholic culture had provided early responses to the Revolution with authors such as Spedalieri and Tamburini. But it is in France that Reactionary Catholicism emerged, since the mid-1790s, as an organic corpus of religious and philosophical doctrines. The reason is to be found in the deep crisis undergone by Catholicism in France since 1790, a crisis which was cultural as well as social and economic. In its French form, Reactionary Catholicism is known as "Traditionalism", and its elaboration was mainly due to the work of Joseph de Maistre, Louis de Bonald and Felicité de Lamennais, two aristocrats and one ecclesiastic respectively. Traditionalist writings have been described by Catholic historians as part of a more general renewal and reinvigoration of Catholic thought after the rather mediocre theological and moral production of the eighteenth century; indeed as "a real spiritual spring"[9]. The spread of the popular missions was one of the first signs of the new reactionary spirit[10]. At the end of the Empire, missionaries began their work to bring France back to Catholicism in the shortest time possible. There was neither space for compromise, nor for internal debate. Gallicanism and Jansenism were fought as vigorously as was atheism. The Church must return to the center of society: this social goal was primary, and it overcame any other theological preoccupation. Thus the stress on symbolism, on public forms of worship, on processions; every single moment of human activity must be signed by Catholic symbols. This missionary renewal was accompanied, in ecclesiastical culture, by an unprecedented preeminence of apologetics over other kinds of theological production. The traditional theological controversies were largely abandoned in favor of the new "demonstrations" of the existence of God, of the immateriality of the soul, of the necessity and social utility of religion[11].

At the fall of the Napoleonic Empire those counter-revolutionary elements in French Catholicism which had been active since the 1790s took the lead in this movement of renewal, and tried to establish its hegemony over the whole of Catholic culture in France. There were a few crucial elements in French Traditionalism which are worth underlining, before moving back to Italy. Traditionalist authors began to publish during the Republic and the Empire. Maistre's *Considerations sur la France* and Bonald's *Théorie du pouvoir politique et religieux* were published in 1796; Lamennais' *Réflexions sur l'état de l'église en France* *pendant le XVIIe siècle et sa situation actuelle* in 1808. Such writings were prepared in response to the exceptional situation of France: every available cultural resource, from the fathers of the Church, to Bossuet, to Rousseau, had to be employed in order to attack the new culture and the new society. As a result, going through the massive out-put of Traditionalists is a supremely tedious experience. Every single argument, whatever its nature and its premises, ends up reinforcing one or other of the few basic tenets of the doctrine. The monotony of the content is only partially compensated by the indisputable writing skills of the authors (the cynical irony of de Maistre, the poetical sensibility of Lamennais). Among the tenets of their doctrines was the identification of social crisis and religious crisis, both originating from the "pride" of human reason, and whose first manifestation was the religious reform of the sixteenth century. The restoration of the "principle of authority" both in the Church and in the state was, consequently, the primary goal of Traditionalists. Every author contributed to this program from a somewhat different perspective.

Maistre, from the province of Savoy, in the Kingdom of Piedmont, ridiculed the ideals of the Revolution, the principles of the Enlightenment and the pride of the modern sciences. He showed the paradoxes and the "artificiosity" of both encyclopedic knowledge and constitutional forms of government. The Traditional order had been broken, and it must be restored, in knowledge as in society. In knowledge, human reason must recognize its own limits: "the masterpiece of reason is to discover where to stop reasoning"[12]. Reason is nothing more than "a trembling light", unable to guide human action without the support of the dogmas of Tradition: "this is what man needs, not unfounded systems based only on what they call *reason* and which is simply *reasoning;* man needs prejudices, practical rules, sensible, material, palpable ideas"[13]. Equally abstract and misleading is the notion of "man", as a universal concept. There never existed anything known as "the man", to which laws should be referred; there only existed specific people, and specific, locally valid civil laws. The idea that laws must be written down in the form of a constitution is a symptom of crisis of the institution: "the more one writes, the more the institution is weak"[14]. In politics, Maistre criticized any form of contractualism. There never existed such a thing as the absolute "state of nature", so the origin of society was necessarily transcendent. "To talk of nature as opposed to society is to talk nonsense", Maistre wrote criticizing Rousseau[15]. In fact, the evidence is that society and sovereignty appeared together; that of the original covenant being only a myth. And the only plausible explanation is that God himself created human society and gave to it its original laws. God is then the only legitimate legislator, and the real source of sovereignty. What is left to men is the mere re-elaboration and codification of the original divine legislation. Indeed, "one of the greatest errors of this century was to believe that political constitutions were a human creation; and that a constitution can be made as a clock is"[16]. This is why "the greatest calamity of the universe has always been *philosophy*, which is human reason acting on its own"[17]. A constitution is the useless attempt to write down the rules of the form of life of a specific nation, whose origin is transcendent. Consequently, sovereignty is essentially absolute, indivisible, and unaffected by any mundane limitation. Whatever the form of a state is, power must be in the hand of a single actor, and must be absolute, according to the principle that *princeps solutus est legibus*. This makes monarchy the most "natural" form of government, even if specific local conditions have always to be taken into account in such considerations. In fact, "the art of reforming governments does not consist in subverting and re-building them according to certain ideal theories, but rather in bringing them back to those internal and hidden principles discovered in the ancient times"[18]. Prior to writing and to complex culture is the intuitive knowledge about nature and society that God himself gave to mankind. This knowledge is essentially non-discursive, and every attempt to conceptualize and systematize it would end up compromising its truth ("writing is always a sign of weakness, of ignorance, of danger; the more perfect an institution is, the less it writes").

The only antidote to the disruptive action of individual reason is the defense of the "organic" and "compact" world of European Christianity. Sceptical about the effects of the Vienna Congress, Maistre presented in his *Of the Pope* (1819) an ambitious theocratic project. Europe can be saved only by the Catholic principle, according to which truth and authority are one and the same thing. Indeed, the metaphysical principle of the "unity of authority" finds its best expression in the conjunction of spiritual infallibility and temporal sovereignty. The absolute authority of the Pontiff is of the same kind as that of kings, but much superior as it is "universal". The authority of the Pope is then the necessary basis for every temporal authority; take this basis away, and the whole society would collapse. "There is no society without government, no government without sovereignty, no sovereignty without infallibility"; infallibility is "absolutely necessary" to avoid the dissolution of society. Maistre's considerations on power are, so to speak, "structural"; he did not deny that the exercise of power of certain monarchs can be tyrannical —but this is not the point. Such contingent factors do not affect the argument for the necessity of the integrity and infallibility of power. Europe has to find its way between the "two abysses" of tyranny and anarchy: only the supreme authority of the Pope —as universal mediator between peoples and temporal sovereigns— can save it from self-destruction, in the form of a modern *res publica christiana*.

Bonald worked on grounding these tenets on a sound philosophical basis. The restoration of the principle of authority can be successfully completed only by rejecting the "individualistic philosophy" of the eighteenth century (by which he refers to both sensationalist and rationalist trends). The focus of philosophical reflection must move from the single individual to society as a whole. Indeed, Bonald found it overly abstract to study the natural constitution "of man"; what one can do instead is to study man as shaped by society, since "man only exists in society". This means every contractualist theory about society must be rejected, as society "preexists" man. Its origin is, in fact, divine. In this perspective, Bonald can provide a metaphysical foundation for the claims of the contemporary apologetic production. So, for instance, the crucial alliance between absolute monarchy and the Catholic Church is justified by referring to the "natural constitution" given by God to both society and the Church[19]. If in Maistre it is Providence that guides —often mysteriously— the history of mankind, in Bonald the inclination of religious and social life towards specific forms of organization (i.e., absolute monarchy and the Catholic Church) is due to metaphysical necessity. The nature of the elements which form each "society" determines the tendency towards specific forms of social and religious life, which are *not* the result of calculation, but the incarnation of the divine "constitution" of these two societies (by "constitution" Bonald means here the set of necessary relations existing among the elementary components). This tendency can be temporarily contrasted by ill-judged human action, but in the end the "real constitution" will always impose its necessary relations. According to

Bonald power is essentially absolute, indivisible, and its fragmentation coincides with the disintegration of society, when in the absence of a true "general" power, everyone exercises his own "private" power. Nature reacts to such deviations with "violent explosions", such as revolutions. When dealing with the "natural laws of social order", Bonald is particularly explicit about the function of religion and knowledge in preserving traditional social order:

> Existence et unité de Dieu, spiritualité et immortalité del'ame, ces dogmes sont vrais parce qu'ils sont utiles à la conservation de la societé civile [...]. Tout ce quie est utile à la conservation de la société est nécessaire: tout ce qui est nécessaire est une vérité: donc toute les vérités sont utiles aux hommes ou à la société; donc tout ce qui est dangereux pour l'homme et pour la société est une erreur.[20]

Particularly successful was Bonald's social theory of language. Language is described as necessary to articulate the most simple thoughts, so that it is impossible for language to be the product of a human invention: "man cannot invent without thinking, and he cannot think without signs". Typically, Bonald concluded that "one must refer to a being other than man to explain [...] the art of expressing our thoughts through words"[21]. The basic elements of language are a divine gift. God gave them to mankind, and in them were already deposited all the basic truths about nature, religion and society. These truths manifested themselves through the historical use of language; the result of this historical process was the creation of a cultural and social Tradition (the Hebraic-Christian one), which must be held as the only guide in political action. Such a theory of language allowed Bonald to defend a form of "social innatism", which differs from Maistre's Platonic innatism. The theological resonance of Bonald's argument is clear: as God is known only through its word, so the laws of society are only known through our common language, i.e. through Tradition. From language, which is conceived as coextensive with thought, mankind receives the idea of God which provides the basis for any other idea, from that of human reason to moral, social and political ideas[22]. Consequently, truth cannot be achieved individually; it manifests itself in Tradition through language. It follows that eighteenth century *ideological* investigations inspired by Locke are useless exercises where the human spirit "extenuates, consumes and desiccates itself in a sterile self-contemplation"[23]; because it is "outside" that we have to look, when searching for "the certain basis of human knowledge", and for "the criteria to tell truth from error". This basis must be external, but not material; objective, but not sensible; and it must be a priori, certain. It is language, the words, which "make" man as well as society. Note that the possibility of a materialistic foundation of knowledge and society is ruled out by Bonald, who argued, against the physiological foundation of reason theorized by the *ideologists* (he referred explicitly to Cabanis), that matter and spirit are completely separated; that intelligence is substantially different from the body and it is in fact "served by the organs"[24].

Lamennais, the youngest among these Traditionalist authors, defended the same principles well into the age of the Restoration. He was less inclined to use that pseudo-medieval mythology which abounds in the writings of Maistre and Bonald; instead he was at the forefront of the religious debate for an authentic spiritual renewal of the Church. He himself was an ecclesiastic, and his influence on Italian Reactionary Catholicism was certainly deeper than that of the previous authors. In his writings we find again the issues of the organic relation between social and religious principles; of the Reform as original rebellion against the divine order; of the essentially subversive function of the main philosophical and theological doctrines of the eighteenth century, from rationalism and sensationalism to Gallicanism and Jansenism. Lamennais' most original claims are those relative to the attribution of grave political and moral responsibilities to the monarchies: they have in fact caused the recent social disorders by supporting reformism in society and religion. Indeed, Lamennais theorized the supremacy of religious authority over civil authority: Europe must become a single great theocracy. Lamennais soon became the most read of the Traditionalists; his *Essai sur l'indifférence en matiére de religion* (first volume published in 1817) sold around forty thousand copies[25]. The book criticized the increasing secularization of culture and society, and it pointed to the theocratic form of state as the solution to disorder and violence. The target of the book is not some specific erroneous doctrine, but the modern "spirit of indifference". This is the attitude of those philosophers who have renounced any search for truth, who do not believe in God, and do not even care to deny him; who do not commit themselves to any doctrine. It is a state of "spiritual sleep", the "tomb of intelligence", the nihilistic conclusion of the philosophy of the Enlightenment[26]. Under the label of "religious indifference" Lamennais grouped a number of different positions whose common aspect was the non-recognition of the supreme authority of the Catholic Church and, in its structure, of the Pontiff. Lamennais analyzed instrumentalist visions of religion, deism, and Protestantism, and concluded that all these positions lead, ultimately, to atheism and to the divinization of human reason. The terrible effects of these theoretical positions upon social order had been clearly shown by the Revolution. Following a typical argumentative form of Traditionalist literature, Lammenais moved from the alleged effects of certain ideas to their theoretical evaluation. Again we find the idea that human reason must know its limitations, as man alone cannot know any certain truth. One should indeed distinguish between the capacity to know, to "perceive" truth, and the operation of reasoning, which is "the spiritual operation by which one discovers relations among known truths and deduces consequences from them". It is with reference to this second sense that "reason" is said to be weak, erroneous and insufficient. In fact, the complete knowledge of a truth excludes reasoning, as it is a perfectly clear intuition. But if reasoning (*raisonnement*) is deceptive, how can something be certainly known? The only guarantee is common sense (*sensus communis*), the universal consensus. Like Bonald, Lamennais provides a "social" alternative to individual reason as a source of certainty. Every sort of knowledge, from social relations, to justice, to morals, is grounded in the authority of the universal consensus; certainty is a social production[27]. Common sense supports the fundamental truth, the existence of God, and from this knowledge every other knowledge descends. Individual reasoning is then contrasted with *believing* what the common sense states. To believe is to respect a testimonial, and to obey an authority. Only authority can tell truth from error, and then only authority can point at the true religion. Believing in the autonomy of individual reason is the great error of modernity: the self-foundation of individual reason cannot but end up in scepticism. All this proves the invincible necessity to believe; and indeed faith is the foundation of human reason, as it provides the basic truths on which reasoning can be performed. Traditionalists never detach their epistemological and ontological considerations from the political dimension. So, Lamennais says, the political equivalent of the primacy of individual reason over authority and common sense is the democratic doctrine (*democraticisme*). In a democracy, nothing is stable, everything changes following passions and opinions, so that the people and their leaders are "dragged" towards destruction. Once again, Christianity is in fact the only antidote to social crisis[28].

The remarkable success of Traditionalist authors shows that the cultural atmosphere was favorable to the reception of such themes, and to a new mystical form of religiosity. Think of the reverberations caused by of Fredrick Schlegel's conversion to Catholicism in 1802, for instance; or of the enormous popularity of Chateubriand's *Génie du Christianisme ou beautés de la religion chrétienne* (1802). Chateubriand presents Christianity as crucial to the spiritual life of Europeans. His Christianity is nostalgic and filtered by an aesthetic sensibility, the underlying assumptions being those of Traditionalism. An overview of the contents of this book can provide an idea of the features of this new apologetic literature specifically designed for the wider (non-ecclesiastic) public. The goal of the book was to contribute to the restoration of the positive influence of revealed religion upon every aspect of human life. In the first part of the book the dogmas and the "mysteries" of Catholicism are presented, and their truth is defended according to the new apologetic style; the notions of vice and virtue are discussed; the existence of God is proved "par les mervailles de la nature"; the immortality of the soul is proved "par la morale et le sentiment". The second part deals with the "poetics of Christianity", and the main topics are: the poetical work of Christian authors (including Dante and Milton); the allegorical (Christian) meaning of Greek mythology; the nature and importance of passions (religion itself is described as a passion); the nature of the supernatural entities. The third part deals with fine arts, philosophy, and history as inspired by religious feelings; atheism is recognized as the main cause of the historical decline of taste and ingenuity. The fourth part deals with various aspects of Catholic worship, which includes the furniture of the churches, the religious songs, the prayers, funerals, the mass, the regulations for the clergy, the missions, the military orders, and so on. The book is concluded by a chapter entitled "services rendus à la société par le clergé et la religion Chrétienne en général".

A few central themes are obsessively recurrent in Traditionalist literature. They are all part of a reaction against the process of secularization of state, society and culture. The process had been evident during the whole century, but its speed increased dramatically with the Revolution and the Napoleonic Empire. The way to reverse this process was, to their eyes, to restore the "principle of authority" both in politics and in religion. The authority of the Church must not be discussed, it is the repository of absolute truth; and inside the Church, the authority of the Pontiff is supreme and ultimate. Consequently Traditionalists focus upon certain aspects of religious experience while underplaying others. The institutional, hierarchical dimension and the missionary spirit are predominant, as the need to reconstruct the lost unity of the Christian society; conversely, the sense of grace and the individual dimension are absent. The contact between God and the believer is presented as necessarily mediated by a number of different institutions whose authority is itself absolute and unquestionable. On the political side, Traditionalists asked for the unity and the absolute independence of sovereignty; any constitutional concession would necessarily result in political chaos. The modern state is founded on the contingent interests of the ruling groups, which makes it essentially unstable; contrarily, the Traditionalist state is grounded upon transcendental and immutable values derived by the revealed religion and by its historical incarnation, Tradition (to be found in language, or in common sense). Traditionalists are inspired by the pre-modern state, where "not only did one not think of separating the Church from the state, but the very idea of such a separation was inconceivable, it was meaningless"[29]. Consequently, they opposed strenuously the secularization of education; the abolition of religious censorship; and any form of religious tolerance (which is equated with "indifference"). Another crucial target was the process of political and administrative centralization of the state, which had reached its most advanced stage under the Empire. It has been remarked that behind the presence of this anti-centralist theme were "the forces of the *ancien régime* which, by the pen of Chateaubriand, demanded the restoration of the ancient local autonomies as the presupposition of an aristocratic revival"[30]. We can add that, as it emerged from our previous considerations on the Neapolitan feudal-communal system of land, the interests supporting local autonomies and intermediate bodies were not only those of the ancient feudatories, but they could be of a very different nature.

Unlike ordinary counter-revolutionary literature, the work of the Traditionalists was intended not simply to fight the revolutionary principles, but to show their irrational and unnatural character. The principle of sovereignty is transcendent, and individual human reason is subordinate to the pre-conceptions of Tradition. Revolution is in-human and, in the end, its is logically impossible.

4.3 Reactionary Catholicism in the Italian States

The diffusion of forms of intransigent Catholicism in the Italian states was characterized by specific circumstances which differentiated them in many ways from French Traditionalism. I shall henceforth use the general term "Reactionary Catholicism" when referring to the productions of Italian authors. Essentially, they had to face a situation which was not as radically changed as the French situation. The political forms of the restored Italian states and the presence of the Church in their internal affairs were indeed relatively close to the pre-Revolutionary situation. Another crucial point is that in the Italian states the control of the Roman curia was much more effective. The fortune of the "ultramontane" authors (as the Italians called those close to French Traditionalism) was thus linked to the political and theological orientations of the Roman curia and of its docile and faithful instrument: the restored Society of Jesus.

It was only after 1820 that Reactionary Catholicism appeared to be well organized all over Italy. By that time, a network of personal relations, correspondence, periodicals and publishers was working efficiently to diffuse the work of French Traditionalism and of Italian intransigent Catholic authors of the eighteenth century. Unlike in France, the movement was mainly composed of ecclesiastics, whose action was directly supported by the restored governments. Three main centers were the backbone of the movement: Turin in the North; Modena in the Center; and Naples in the South. Not surprisingly they had been the centers where early forms of intransigent Catholicism had already been elaborated by local ecclesiastics in the late eighteenth century. This cultural heritage, and the fact that they were host to three of the most conservative regimes in the peninsula, favored their emergence as main centers of Reactionary Catholicism. A necessary condition for an incisive action of the reactionary groups was indeed the rejection by local governments of any regalistic and jurisdictionalist policy.

In 1817 the "Christian Friendship" founded by the ex-Jesuit Diessbach in Turin around 1780 was transformed in a "Catholic Friendship". Its goal was the diffusion of "good press", which included pieces by Gerdil, Bossut, Marchetti, Haller, Bonald, and Lamennais[31]. The association had a distinctive aristocratic and anti-bourgeois nature, the same as was well exemplified by the Piedmontese Maistre. The aristocratic group was close to the government, which had been completing the most radical return to the past to be seen in Italy (which included: abolition of every law issued after 1800 and a return to the 1770 statutes; abolition of the Napoleonic code; restitution of education to the Jesuits; restoration of guilds, corporations and internal barriers; limitations over import and export; expulsion of compromised professors from the university). Similarly, in the small Duchy of Modena, one finds the ideal political conditions for the constitution of an active reactionary group. The safe town of Modena was to be a core of the whole Italian movement.

From 1820, Reactionary Catholics founded their periodicals. The first one was the Neapolitan *Ecclesiastic Encyclopedia*, directed by the Theatin Gioacchino Ventura in 1821. We will consider the work of Ventura in the next paragraph, when dealing with the Neapolitan situation. In 1822 *The Friend of Italy* began to be published in Turin under the direction of Marquis Cesare d'Azeglio. The attachment to the legitimate dynasty and to the Pope is the line of this rather poor periodical. In the same year *The Memoirs of Religion, Morals, and Literature* appeared in Modena, directed by the ecclesiastic Giuseppe Baraldi (1788-1832), professor of Ethics at the local university, and with the collaboration of well-known academics such as the mathematician Paolo Ruffini. The ideological framework was the same for the three journals, but the tone and the quality were rather different. Ventura found himself in the middle of a political battle for supremacy over the Neapolitan government, which makes his tone violently polemical and the articles very specific. In Modena political life was much quieter, and the academic component was more relevant; indeed, Baraldi aimed to renew Italian culture, and to contrast the flow of "evil books" by using the best scholars available in every branch of knowledge[32]. Particularly interesting was the attempt to de-mystify the use of scientific knowledge made by the *philosophes* and the Jacobins in order to legitimate their political action, and to show that the sciences are best practiced in the framework of a solid Christian education. Also remarkable was the critical response to the liberal conception of "patria" (fatherland), which included the whole Italian peninsula and was the basis for the liberal-unitarian movement. The contributors of the *Memoirs* accepted the value of *patria*, but the term referred to the village, the family, and to the religion of the ancestors.

The key figure of Reactionary Catholicism was that of Gioacchino Ventura. By following his actions we shall reconstruct the parabola of the whole movement and we shall describe the transfiguration of Reactionary Catholicism into Neo-Scholasticism, which was to be dominant in the Catholic Church from then onwards. The battle of Ventura began in Naples.

4.4 Naples: from Eighteenth-Century Anti-Modernism to Reactionary Catholicism

The reaction against the cultural enterprise of the *Encyclopédie* and the defense of the dogmas of Catholicism from the attacks of the *philosophes* had begun in Naples. Naples, thanks to Genovesi's school, had been a main center of the Italian Enlightenment; it soon became a main center of Catholic reaction. Its cultural tradition offered much material to the new apologetic effort of Catholic authors, and the reactionary policy chosen by the government since the early 1790s favored the organization of the movement and its control over Neapolitan culture. Still, the political conditions were not as favorable as in Modena, given that the reactionary elements of the government had to face, since 1815, the powerful opposition of the ex-Napoleonic elite which inclined to a moderately liberal and centralizing policy, according to the general orientations of France and Austria. Neapolitan reactionary forces directly participated in the battle for power which took place in the years of the Restoration. Significantly, the Neapolitan movement enjoyed particular strength in the crucial conjunctures of the 1790s, of 1815 and of 1821, that is to say when the monarchy needed the support of the most reactionary elements to face specific socio-political problems. The alternate fortune of Reactionary Catholicism in Naples, and its contrast with rival political and cultural conceptions, make the Neapolitan case a most interesting one. In between the situation of Modena and of the Italian states under the influence of Austria and France, Naples was indeed the scene of the most direct clash between the forces of reaction and those of moderate liberalism. The whole of its culture was deeply shaped by such a clash.

In Naples the culture of Catholic reaction could count on valuable resources, largely derived from the anti-modern campaign which had been organized in the late seventeenth century to respond to the new atomistic philosophy (see **Appendix 4**). It was a reaction which mobilized scholastic philosophy and Catholic orthodoxy to fight the emergence of a secularized culture and a more individualistic vision of religion. Since then the issues of the role of the Church in social and cultural life, and of the relation between state and Church had been central to Neapolitan culture. The eighteenth century was indeed characterized by the jurisdictionalist controversies over the influence of the Roman curia in the kingdom; not even in its most successful years did the anti-curial front (which reunited Genovesi's school and Jansenist clergy) manage to neutralize its opponents. This is clear from the university reform of 1777, which compromised with the requests of the Roman party (for instance, the chair of Decretals, defined by Genovesi as "the codex of the universal monarchy of the Roman curia", was maintained). The defence of the temporal role of the Church found its main cultural expression in the activity of the *Congregazione dell'Oratorio* (Congregation of the Oratory) of Naples. The Neapolitan Oratory had been founded in the sixteenth century, on the model of the Roman Oratory run by Filippo Neri. A typical post-Tridentin institution, its main goals were to renew the apostolic mission and to take care of the education of the young from poor backgrounds. In 1741 the Fathers of the Oratory asked permission to open an Academy of Ecclesiastic Sciences in their remarkable House facing the Cathedral, under the official patronage of Cardinal Giuseppe Spinelli, Archbishop of Naples. The academy was the main center of elaboration of anti-modern thought in Naples during the second half of the century. Its goal was the confutation of heresy in order to enlighten Neapolitan clergy, and its productions were almost exclusively apologetic ones. Remarkable and unprecedented was the prevention of secular scholars from joining the academy. The heart of the academy was the famous Library of the Oratory, one of the attractions the town offered to foreign visitors, and the place where the philosopher Giambattista Vico had mostly worked. The collection of the library included patristic texts, treatises of dogmatic and moral theology, texts of ecclesiastical history and biblical chronology, and also texts of Protestant theology, anti-Jesuit pamphlets, as well as recent productions in the natural and mathematical sciences[33]. The members of the academy, professors, bishops and missionaries, were mostly Oratorians, but Theatins, Franciscans and Dominicans were also represented. In 1747, Genovesi himself was invited by the Archbishop to participate in the reunions of the academy; he reluctantly read a dissertation on the Christian conception of hell, which was strongly criticized by academics for its weak commitment to the dogma of eternal punishment. In this very period Genovesi failed to obtain the chair of Theology at the RUN and ended his career as a theologian. He did not participate any more in the academic reunions: the intransigent position of the Neapolitan academics was in fact at odds with Genovesi's attempt to conciliate modern philosophy and Christianity[34]. As the reactionary crusade of the Neapolitan Church against modernity became manifest, the Catholic Genovesi placed himself on the other side of the barricade. After the appearance of the first volume of the *Encyclopédie* in 1751, deism and "religious indifference" were the most recurrent polemical targets of the academic speeches. These were mainly grounded in the patristic literature, which was taken as a source of indubitable truths. The clear intent of this strategy was to make it extremely difficult to establish a real dialogue with secular adversaries. The academy offered young authors the opportunity of improving their skill in philological and exegetic techniques, but always in a rigidly pre-defined perspective where any doubt and any variety of interpretations was perceived as a deeply negative phenomenon. Among the themes treated by the academics in this early period were the dogmas of the Immaculate Conception of the Virgin, the miracles, the transubstantiation, the primacy of the Pontiff, the structure of the Church and its infallibility[35]. Each year the academy concentrated on a specific "enemy of the Catholic faith", to obtain the greatest effect. The "pure and spotless truths" of religion were mostly defended against Protestants or against the supporters of forms of "Enlightened Catholicism", where faith and reason were conciliated along the lines of John Locke's argument for the reasonability of Christianity. Any sort of religious tolerance was similarly opposed because it fell into the category of "religious indifference"; this concept was elaborated to justify the attacks of the Neapolitan academy against a number of different philosophical positions, and it was to be used well into the nineteenth century (e.g by Lamennais). Among the early "indifferent" philosophers attacked by the academicians was Raimondo di Sangro, the mid-century leader of Neapolitan Anglo-Dutch freemasonry. The fight against masonic "indifference", "pure naturalism" and "Spinozism" (i.e. pantheism), marked the beginning of the anti-modern campaign of the Neapolitan Church. By 1753 the academy had ceased its works, due to the departure of Spinelli and the death of his main champions. In 1758 it was restored by Cardinal Antonino Sersale, under the name of Archiepiscopal Academy as members met weekly in the Archiepiscopal palace. Themes of the sessions were Theology, Canon Law, History of the Church and the Liturgy. After another interruption of around five years, the academy was eventually re-opened in 1780 by Cardinal Serafino Filangieri with explicit anti-encyclopedic aims. A former professor of the Roman College, Filangieri held the chair of Physics at the RUN. The academy, divided into the two branches of Moral Sciences (thirty-nine members) and Theological Sciences (thirty-seven members), returned to the palace of the Oratory. The confrontation was now with the Neapolitan reformist thought of the 1780s. Among the members was the well known apologist Giovanni Camillo Rossi, the great enemy of deism in Naples. His work shows how the style and the goals of apologetics had been changing in the 1780s and 1790s[36]. The new apologetic had explicit political implications, aiming to prove the divine nature of the authority of both legitimate sovereigns and the ecclesiastic hierarchies. Indeed the new political alliance between the Bourbon monarchy and the Pope (1791) found in this new apologetics its cultural legitimization[37].

The Catholic anti-modern trend remained marginal to Neapolitan culture until around 1791, when the political alliance with Rome was integrated by a general re-orientation of the whole cultural policy. Accepting the Roman interpretation of the Revolution as a "great philosophical rebellion" left no space for further activity by the Regalist, Jansenist and Gallican clergy. The supremacy of the Pontiff was no longer a matter of discussion, and the crusading spirit of reactionary clergy was fully supported by the Bourbon police and censorship, particularly after the discovery of the Jacobin conspiracy of 1794. This pre-Revolutionary phase of Reactionary Catholicism was characterized by the febrile activity of the members of the Archiepiscopal Academy and of a very particular literary association, the Royal Arcadia. Between 1794 and 1796 the Dominican Vincenzo Gregorio Lavazzoli (a member of both) emerged as one of the champions of the anti-philosophical campaign thanks to his contributions to a periodical specifically designed to present the reader with "healthy readings". The defence of religion was joined with a demand for a theocratic organization of the state. To counteract false Jacobin "regeneration" one must recover "the anchor of public safety": subordination to authority. The Royal Arcadia was another important institution which contributed to the elaboration of Reactionary Catholicism. It was a secular institution, founded in 1794 by the lawyer Vincenzo Ambrogio Galdi "to fight the atheistic and heretical errors of the eighteenth century"[38]. Galdi had been promoting an anti-Masonic and anti-Encyclopedic literary society in Salerno since 1759, the *Accademia degli Immaturi*. In 1792, he decided to move to Naples in order to pursue a more effective counter-Revolutionary action. The academics asked the King to add to their institution the attribute "Royal", which was immediately accorded. The Arcadians founded a number of "colonies" all over the kingdom, enrolling influential members of proven legitimist and Catholic convictions, which were confirmed under a pseudo-Masonic oath. The statutes of the society offered the profile of the ideal Arcadian, who was an intellectual respectful of the legitimate sovereign, of the dogmas of the Church and who used his knowledge only to become more virtuous. In fact, they were a manifesto for the mobilization of culture in defense of religion and monarchy. The most popular churches were used for the ceremonies of the Arcadia, and on these occasions pamphlets and books were freely distributed. The Arcadia had its own Printing-Office and the exceptional authorization to print its texts without waiting for the approval of censorship. It is significant that the Arcadia was placed under the protection of the Holy Trinity. In Reactionary Catholicism, as in French Traditionalism, the anti-deistic dogma of the Trinity was a crucial symbol. It was indeed seen as the basis of all the "mysteries" of Catholicism, the dogma which required the greater submission of human reason to revealed truth. The rebellion of reason against this dogma was considered as one and the same with the rebellion of the egoist bourgeois against his legitimate sovereign[39]. The text which presented the Holy Alliance to the world famously begins with the words "In the name of the Very Holy and Indivisible Trinity".

With the 1799 Revolution, the activity of the Arcadia became clandestine. Its capillary structure permitted indeed the organization of an active counter-revolutionary movement, which supported in many ways the crusade of Ruffo's Holy Faith Army. Ruffo himself was an Arcadian, as were the bishop-officers who were assisting him on the battlefield. Membership of Arcadia during the Revolution is one of the few sources for investigating the composition of the reactionary groups. Around one third of Arcadians were ecclesiastics, mostly abbés teaching at various levels in the colleges and in the universities of the kingdom. Of the seculars (70%), half were aristocrats, mostly from the lower provincial aristocracy, and the rest were commoners, mostly lawyers, who had often invested in land, which they administered traditionally, as absentee landlords. A few were physicians and military officers. This seems to confirm Genovesi's claim that the main opposition to a serious reform of the state (in 1760s) was to be expected mostly from the three "conservative orders": aristocracy, lawyers and clergy.

4.5 Aristocratic Reaction: the Invention of the Middle Ages

Among the books diffused by the Arcadia were *The Trinity* (1795) and *The Utility of Monarchy in the Civil State* (1795), by the Arcadian Isocrate Larisso, alias Antonio Capece Minutolo Prince of Canosa (1768-1838). We met Canosa while describing the events of the 1799 Revolution; in that context he acted as leader of the ancient legitimist aristocracy, for which he claimed back full feudal rights. His aristocratic vision of society had eventually compromised his own position at court, and cost him arrest. At the restoration of the Bourbons in 1815 he was to be called back as Minister of Police, and again in 1821, after the defeat of the constitutional movement. His political life was difficult though, as the direction of Neapolitan policy was in the hands of moderate conservative groups in line with Metternich's policy. This moderate conservative policy was best represented by Luigi de' Medici, formerly linked to the Neapolitan enlightened tradition. Metternich himself backed Medici's line, as he was considered the only person able to save the finances of the kingdom (and to repay the debts to Austria). It has also been noticed that Medici had important links with the financial oligarchy of the capital, which had consolidated his power during the French occupation. Among them were a branch of the Rothschild family, whose opinion was highly regarded in Vienna. To politicians like Medici the ideas and the methods of Canosa would seem desperately outmoded, as was his black seventeenth-century suit (for which he was known as "the Black Prince"). To Metternich, Canosa was a dangerous "hot head".

But in the most critical periods Canosa, the hammer of freemasonry and Jacobinism, had been an important counselor of the Bourbon court, an ambassador, and a minister. Even more importantly, his writings enjoyed a remarkable success in Naples and abroad. Canosa was certainly expressing the ideas of many, including King Ferdinando I, who only reluctantly abandoned his faithful knight when he was ordered by Vienna to do so, in 1821.

Canosa came from a family whose service to the kings and the popes traced back to the thirteenth century (under the Swabian dynasty), and which held a family chapel in the Cathedral of Naples. The Canosas had suffered greatly from the progressive erosion of feudal privileges actuated by the reformist policy of the Bourbon during the second half of the eighteenth century. This family was indeed emblematic of that part of the sword aristocracy which was unwilling to turn itself into a courtier aristocracy, and unable to face the agricultural crisis by moving from a traditional absentee administration of land to a "modern" administration. The new centralizing policy and the attempt to get rid of the feudal-communal system, with its plethora of intermediate bodies —while supporting new forms of agricultural production and commercialization— had grave effects upon the Canosas. The French occupation of the kingdom and the anti-feudal laws of 1806 precipitated their decline. As the family lost its feudal rights upon the town of Canosa, economic ruin became unavoidable. Canosa was born into a powerful and rich feudal family in 1768, but by 1816 he was living on a state pension.[40].

These considerations make it difficult to understand the standard historical judgment which has been given on Canosa: that he was a naïve idealist, a disinterested paladin of the *ançien régime* who sacrificed his fortune to his anachronistic cause. In fact, when Canosa decided to enter active political life his fortune had already disappeared. The image of the disinterested paladin was originally drawn by Canosa himself in his memoirs; and that this image has been taken for granted by the most recent historiography testifies to his remarkable ability in mystifying and idealizing what was the last battle of the traditional feudal aristocracy against emerging groups of financiers, investors and landowners. Biographical errors have probably contributed to the legend of the disinterested knight. Croce, who supported the idealistic thesis, claimed that Canosa had been educated in the ancient values of the family and that "he had sucked Catholic religion with his mother's milk". By looking at his correspondence and private archive, Maturi reconstructed quite a different story. Canosa had frequented the famous Jesuit College *Nazareno* in Rome, studying philosophy and the sciences; in 1786 he wrote a dissertation of anatomy on the different parts of the human body, their disposition and functioning[41]. In 1787 he was back in Naples to administer the feudal possessions of the family. It was the period of the fiercest anti-feudal policy (Caracciolo was Prime Minister) and in few years Jacobinism was to threaten Naples. "I entered the world" Canosa wrote, "precisely when in France disorders were beginning due to the sects and to the perverse philosophy, which brought so many calamities to that very rich kingdom and to the whole of Europe"[42]. Following "the facts of France" Canosa began to deepen his knowledge of Catholic dogmas, "as it seemed to me that the question was most important", and "this is how I became Catholic". Canosa dated his decision to abandon his previous "Pyrrhonism" and "semi-atheism" from the crucial year 1794[43]. From that time on he was to be the most popular author of Reactionary Catholicism in Naples. Significant also are the spiritual guides chosen by Canosa: Nicola Spedalieri and Stefano Borgia, i.e. those Italian ecclesiastics who were explicitly supporting the counter-revolutionary use of Catholic religion[44]. Nicola Spedalieri had been the early theorist of theocratic society; Cardinal Stefano Borgia (1731-1804), was a leading "intransigent" cardinal in Rome, and the most firm opponent of Neapolitan Jansenism and Regalism during the 1780s (his direct adversary being abbé Giuseppe Cestari). Borgia was also the author of recent counter-revolutionary pamphlets[45]. In the following years, a few other authors would add to Canosa's favorite sources. First of all Tamburini, whom he used to substantiate the argument of the empirical and a-geometrical nature of the political and social sciences. Then foreign counter-revolutionary texts such as Edmund Burke's *Reflections on the Revolution in France* (1790) and Augustin Barruel's *Memoires pour servir à l'histoire du jacobinism* (1797)[46]. Barruel elaborated and articulated Spedalieri's argument that the French revolution can be explained only as the final outcome of a long-lasting hidden conspiracy organized by *philosophes*, Jansenists and freemasons ("the sects")[47]. The theoretical apparatus of Barruel's work was to be largely used by Neapolitan Catholic reactionaries, and the conspiracy theory was immediately embraced by the Bourbon court. Canosa reported that Barruel's Italian translation was indeed promoted by the Neapolitan Crown in 1803. Through all his work, Canosa would remain convinced that history has indeed a hidden dimension, which is the field of action of obscure forces, and that the "real", important events are those happening —unknown to most— precisely in this dimension[48]. This "conspiratorial" explanation excluded any social consideration, looking at the moral corruption of a few as the only reason for the revolutions. Canosa also saw the action of freemasonry behind his removal from the Neapolitan government in 1816 and in 1821. He adopted a typical corollary of the "conspiracy theory": the king is "good", but he is naïve and deceived by corrupt counselors (so, according to Canosa, Ferdinando was "the very good but deceived king", in the hands of the Masonic liberals of Medici's moderate government[49]). From around 1800 Canosa read the texts of French Traditionalism, which aroused enthusiasm among Neapolitan reactionaries.

Canosa emerged as an author in the years of his "conversion", when his work provided a historical and philosophical legitimization for the new reactionary policy of the Bourbon[50]. Their importance must not be seen in their specific content, which was rather poor and unoriginal, but in the new, large public to which they were addressed, i.e. legitimist aristocracy and those groups who, for different reasons, had an interest in preserving the feudal communal system (think of the lawyers and the minor provincial aristocracy grouped in the Royal Arcadia). Not surprisingly, the first political-religious productions of the Arcadian Canosa were: a defence of the dogma of the Holy Trinity, and a defence of the institution of monarchy, both published in 1795. *The Trinity* was the work where Canosa announced his new faith to the world; it was essentially a confutation of deism in its many variants[51]. It is argued that mystery is necessary to religion and that any attempt to rationalize religion destroys its very essence. The dogma of Trinity was known to ancient Hebrew and Indian wise men, but it was kept hidden from ordinary people so as not to contaminate its fundamental truth[52]. Note the presence of the doctrine of the *philosophia perennis*, the original corpus of esoteric knowledge (*sapientia*) which has been transmitted from civilization to civilization and finally codified in the dogmas of the Catholic Church. Canosa also defended the infallibility of the Pontiff (which was not yet a dogma), as the necessary basis for stability in the Church, which is the first premise for stability in society[53]. History, Canosa remarked, teaches that every religious insubordination leads to social insubordination[54]. More specifically, in *The Utility of Monarchy in the Civil State*[55], he argued for the impossibility of maintaining social stability within a democratic system of government. The theoretical consistency of Canosa's argumentation seems rather weak when compared to that of his contemporaries Maistre and Bonald, and the tone is overly polemical, due to Canosa's direct participation in political life. The basic elements of Canosa's political ideas are derived from Montesquieu's *The Spirit of the Laws*, the book against which Gaetano Filangieri had written his *The Science of Legislation*. From Montesquieu, published in Naples in 1771[56], Canosa extracted those points which were to remain unchanged throughout his political production: intermediate institutions such as aristocracy and the Church are essential to monarchic governments; consequently every reform aiming to dismantle the power of feudatories ("the jurisdictions of the Masters"), the Church, the Towns, the guilds, and other similar bodies, is in fact threatening the existence of monarchy itself; monarchies are based on the fundamental value of aristocracy: honor (the virtue of chivalry, which pushed Canosa into political activity, as neo-idealist historians have remarked). On the other hand republics can only be based on disinterest and on the absolute and generalized love for homeland. Moving from these tenets, Canosa reached his openly anti-democratic conclusions: it is impossible to establish durable republican regimes in the modern world, due to the ignorance, corruption and violence which are proper to the common people[57]. A democracy, a "government of the multitude", would soon self-destruct. The only viable alternative is the monarchic system. Of course Canosa did not refer to the modern absolute monarchies; his model was rather some sort of feudal monarchy, whose power is sustained by feudal aristocracy and by the structure of the Church, and more generally, by all those intermediate and local bodies which are proper of the feudal-communal system of land[58]. In line with his medieval conception of feudal monarchy Canosa, in 1796, defended some fellow aristocrats from alleged governmental abuses, and criticized the government for introducing a new tax in Naples without previously consulting the ancient representative organs of the town, which gave a voice to aristocracy and to artisan guilds[59]. Meanwhile, Canosa frequented the house of Lord Hamilton, the British ambassador, where he expressed his admiration for Burke's idea that the moral and political sciences must be based on experience and not on abstract speculations. Canosa's political battle continued with an attack against a royal magistrate who had recently questioned the privileges of feudatories in military matters[60]. The book became immediately famous; it was indeed an unprecedented and courageous defense of the feudal system in face of the centralizing Bourbon monarchy. At the suggestion of Cardinal Borgia, this anti-absolutist pamphlet was very positively reviewed in the *Ecclesiastic Journal of Rome* and in the Venetian *Literary Gazette*. Canosa had officially entered the group of Reactionary Catholic authors[61].

In 1798 a French army headed by General Championnet moved from Rome towards the Neapolitan border. In accordance with his conception of aristocracy as a crucial element for the defense of the state, Canosa "left the pen for the sword" and personally recruited soldiers on his land, participating in the military campaign. As the government and the royal family left Naples, he was elected by the aristocratic parliament to lead the "Extraordinary Deputation for Good Government and Internal Tranquillity". Canosa refused to recognize the authority of the king's representative and, on the basis of some old precedents, he claimed that —in the absence of the legitimate king— the "Town of Naples" was called to represent and to lead the whole "Nation" (the Town of Naples being represented by a parliament of elected aristocrats and members of the guilds). In the feudal view of Canosa such institutions possessed proper juridical authority, and were able to assume their own responsibilities when the situation required it. As we have seen, the negotiation between Canosa and Championnet fell through —mostly thanks to Lauberg. Canosa then called for the "low people" to defend their own town and their own religion from the foreign invasion, and organized the three-day anti-French resistance. At the establishment of the republic, Canosa escaped prison thanks to the intercession of an aristocratic family he had defended against abuses in 1796 (it was the family of Ettore Carafa, a student of Lauberg)[62]. He could then participate to the public life of the short-lived Neapolitan Republic. Unsurprisingly, when it came to the abolition of feudalism, Canosa opposed vehemently the radical faction of Carlo Lauberg and Vincenzo Russo, who supported the complete abolition without indemnity[63]. Russo said feudality "was no right"; but Canosa, and the moderate Jacobin faction headed by Pagano, claimed that the republic had inherited the duties of the extinguished monarchy. Interestingly, Canosa moved from juridical considerations to sociological ones: he remarked that those who attack feudal rights more violently are not "the poor, but rather those few wealthy people who live in each town", who control the administration of the universities and who hate the ex-barons and "tyrannize the population to get rich at their expense"[64]. Canosa's description of the aggressive landed bourgeoisie, the "gentlemen" (*galantuomini*), was certainly based on first-hand experience. For a while the ex-aristocratic Jacobins managed to stop the law, but this was eventually promulgated on the 27th of April 1799. Meanwhile Canosa had been arrested in connection with a legitimist conspiracy, for which he was sentenced to death. But the republic fell in a few days, and Canosa ended up with a five-year sentence inflicted by the counter-revolutionary tribunal for "attempting to establish an aristocratic republic". Freed on the occasion of the 1801 amnesty, and temporarily out of the political arena, Canosa reinvigorated his religious vein. In 1802, the year of Chateaubriand's *Génie du Christianisme* and of the conversion of Schlegel, Canosa began a vigorous campaign against atheism, publishing a couple of works which are representative of the new apologetic style of Reactionary Catholicism, where the apology of religion and political reaction are tied up in an indissoluble way. One was an essay "on the passion and death of Our Divine Redeemer", and it was dedicated to the particularly devout King of Sardinia Carlo Emanuele IV of Savoy, who had repaired to Naples in 1800, following the French occupation of Piedmont[65]. In spite of the topic, Canosa found a way to attack the "innovators" of the eighteenth century, and Spinoza, who had questioned the resurrection of Christ. The battle against the *philosophes* continued in 1803, with an interesting satirical pamphlet against the French academics who had been discussing the case of an "incombustible man" [66]. Quoting classical sources, Canosa defended the idea that it is possible to prepare a mixture to protect a man from the action of fire; the *philosophes* who ("as usual") ridiculed this possibility were denying a matter of fact in order to cover their own ignorance. The aim of the pamphlet seems to be that of showing how weak are the reasons for believing that the *philosophes* of the encyclopedist tradition are indeed the "true interpreters" of nature. Meanwhile, in an unpublished memoir "on the decadence of nobility", he returned to the central theme of the role of aristocracy[67]. He pointed out that the reason for its decadence was the anti-feudal and anti-ecclesiastic policy of the Crown, and he suggested that now, with the support of Great Britain and the other counter-revolutionary nations, a solid "aristocratic monarchy" could be established in Naples. He criticized the well-known anti-aristocratic remarks of "the suspect Genovesi", "who is believed to be a genius of our philosophy and the most admirable man of our country", but who was instead an enemy of the throne and the altar, as the intransigent Dominican Tommaso Mamachi —another of Canosa's ecclesiastic sources— had soon understood[68]. In another manuscript Canosa remarked that Genovesi had in Naples a role equivalent to that of the *philosophes* in France, and if this was not immediately clear it was because the cultural conditions of the two countries were very different[69].

Meanwhile, the restored Bourbon monarchy was pursuing an ambiguous policy. The feudal law promulgated by the Republic was abolished, and the Church re-appropriated many of its previous privileges; but the aristocratic parliament of Naples was abolished as well (April 1800), to the astonishment of men like Canosa. It was "the most revolutionary decision taken by the enlightened Bourbon despotism", by which "Neapolitan aristocracy was destroyed as a political body"[70]. In fact it was more a symbolic than a substantial act, given that the feudal system of land remained largely untouched; but it made clear the absolutist direction taken by the monarchy, and its distrust in the ancient aristocracy. During the French occupation (1806-1815) Canosa followed the court to Sicily, from where he coordinated the secret network of counter-revolutionary resistance (the Arcadians). His hope was to convince the king of the error of an anti-feudal policy. At the second restoration of the Bourbon in Naples Canosa was nominated Minister of Police, but his repressive plans, inspired by the reactionary Spain of Ferdinando VII (from which he had been given the Great Cross of the Immaculate Conception), clashed with the moderate policy of Prime Minister Luigi de' Medici. The clash between Canosa and Medici was total, and highly significant; they disagreed on every single point: on economics (free market versus protectionism and lowering of food prices); on the Sicilian question (unification of the two kingdoms and rationalization of the administration versus preserving the two separate identities); on the question of the ex-Napoleonic elements in the administration (amalgamation versus exclusion). Finally, when it emerged that Canosa had intrigued to create a secret reactionary sect (*I calderari*) to fight the liberal freemasons, he resigned (1816).

The anti-liberal and Reactionary Catholic movement remained represented, in the public administration, by men like Giovan Battista Vecchione, President of the Gran Corte dei Conti. In 1818 the king expressed his appreciation of Canosa, awarding him the medal of the Order of Saint January.

Once again out of active politics, Canosa published what was his most successful book, *I piffari di montagna*, which saw six editions between 1820 and 1831. The book was stimulated by an article which appeared in the *Literary Gazette* of London, where his police methods were criticized[71]. The leitmotiv of the book was that a specific legislation is good only for a specific country at a specific time of its history. In this way he could make sense of the "exception" of the liberal Great Britain. The rest was a repetition of previous themes, such as the need for a feudal monarchy founded on the structure of the Church, charged with controlling social and cultural life, and the aristocracy which control the land and is charged with the defense of the country; the need for (violent) counter-revolutionary repression; the need for the Pontiff to be accorded absolute authority and infallibility, in order to prevent religious and social insurrection. The local nature of legislation is explained by Canosa in terms of the essential a-mathematical character of the moral and social sciences. In spite of his habit of expressing his own ideas in a pseudo-geometrical form, Canosa was clear about the terrible consequences of using mathematical speculations in politics. Politics is an empirical science, he claimed; it is not an exact science, it is not a matter of universal and "abstract" principles. In the difficult "art of politics" there is no room for rational discussion: the "meaning" of institutions comes from history. Only a long field experience together with a deep knowledge of the history of the country enables the politician to take his decisions. The solution of a political problem is not obtained as the outcome of a calculation; it derives instead from a judgment grounded on experience. This crucial thesis is defended by arguing that social reality is far too complex to be captured by some set of universally valid laws. Political practice requires natural inclination, acquired skills and a long experience. In the end, "the art of politics" reduces to a private affair of a few wise and experienced individuals: the king and his counselors. In later writings Canosa compared the revolutionary attempts to build a perfectly egalitarian society on a scientific basis to the alchemic aim of finding the philosopher's stone. Also, he used a mathematical metaphor: "[the Neapolitan Jacobins of 1799] seemed to me like an artisan of my knowledge who, being competent in the theory of conic sections, and having a perfect understanding of the geometrical properties of the parabola and of the hyperbola, decided to put the abstract theory into practice to produce a parabolic or hyperbolic burning glass"; but the result was that he wasted a lot of time and good metal, as "there are very many abstract truths which cannot be verified in practice by man, who is an imperfect and infirm being"[72]. Following the pro-constitutional insurrection of 1820-21, King Ferdinando I recalled back Canosa as Minister of Police, but again, his permanence was contested and short. In 1822 Canosa left Naples for good. His activity from then on is not relevant to the present study and no new ideas were presented in his later writings. It may be remarked that he offered his services to the governments of some Italian states, mainly organizing local police forces. Most importantly, he strengthened his contacts with the compact group of Reactionary Catholic publicists active in the Italian states during the 1820s: his fellow-aristocrat Monaldo Leopardi, and the ecclesiastics Ventura and Baraldi. Canosa himself contributed by promoting the Italian translation of Lamennais's *De la religion considérée dans ses rapports avec l'ordre politique et civil*, a crucial text of French Traditionalism[73]. Eventually, in 1830 Canosa settled in the ultra-reactionary Duchy of Modena, where he contributed to the local periodical *The Voice of Truth* (whose motto was *non commovebitur*) with his anti-democratic and anti-bourgeois articles (see Fig.X). By that time Canosa was an anachronistic figure, as even on the conservative front new forms of thought were emerging to replace the medieval conceptions of the Black Prince. He died in the States of the Church, poor and forgotten, in 1838.

With respect to French Traditionalists Canosa played down the direct action of the absolute monarch, and highlighted the crucial role of the intermediate institutions (orders, guilds, local authorities). In fact Canosa's model can only be loosely related to pre-Revolutionary Neapolitan society. He rather looked at medieval Christian society as the perfect example of an "organic society", where the "natural inequalities among men" where mirrored by the social structure, and religion shaped the whole of social and political life. This is the image that Canosa opposed to the "individualistic", "materialist" and "artificial" democratic republic, where the abstract principles of "equality" and "popular sovereignty" were instrumentally used to subvert the natural order of things. In religion, Canosa opposed any reform of Catholicism, whose essence lies precisely in the immutability of the dogmas. He also rejected any attempt to separate religion from social and political life: this separation would destroy the basis of any moral bond, i.e. the very possibility of a stable social structure. Only the Christian believer is a faithful subject. Indeed, the foundations of morals and politics are not to be found in the natural constitution of man or in some original "contract". The only possible foundation is the supreme authority of God, mediated by the temporal structures of the Church and the state. Any non-religious foundation of the morals and of society would be essentially individualistic and thus unstable. Look at that perfect form of natural and organic society which is the family, Canosa wrote. It is certainly not based on a contract; it is simply imposed by the nature of things. In the same way, subjects are liable to social duties without having agreed to any contract.

Historians of political thought associate the figure of Canosa with those of his fellow aristocrats Monaldo Leopardi (1776-1847) from Recanati, in the States of the Church, and Clemente Solaro della Margherita (1792-1869) from Turin, in the Kingdom of Sardinia. In fact they shared basic ideas and the basic political and religious goals. Their work can indeed be taken as the most significant elaboration of Reactionary Catholicism in Italy outside the ecclesiastic circles (in which fell the more coherent work of Spedalieri, Tamburini, Ventura, Baraldi and many others). The three aristocrats shared the same reactionary Catholic ideology, although stressing different aspects of it: Canosa was the defender of the rights of the sword aristocracy; Leopardi eulogized the self-sufficient medieval commune; Margherita mostly argued for the submission of human reason in the face of religious truths, by which political and social life must be inspired. Because they were not active in Naples, and because of the lack of further original themes in their work, we need not analyze their texts. Still, a few words on the figure of Monaldo Leopardi — whose books enjoyed a remarkable success all over Italy— can be useful to complete our picture of aristocratic Reactionary Catholicism.

In many ways Leopardi continued, in the 1830s and early 1840s, the anti-modern battle of Canosa. His *Philosophical Cathechism,* which he wrote specifically for students, effectively summed up the demand of Reactionary Catholicism for inequality and for an unconditional submission to political authority[74]. Being active in the climate of the late Restoration his enemy was not the revolution, but the growing liberal forces and their openly patriotic and nationalistic programs. Against them, Leopardi wrote satirical books and founded *The Voice of Reason*, a periodical published in Pesaro, whose motto was: *praeliare bella Domini*. Leopardi's publications had the privilege of exemption from preliminary censorship. His most popular book, *The Short Dialogues on the Matters of 1831*[75], is a series of witty, ironical dialogues where fictitious characters ridicule such fundamental ideas of the liberal ideology as the constitution, popular sovereignty, and public education[76]. One may remember that Lauberg, already in 1797, had written about the "Gothic barbarism" which was being prepared by counter-revolutionary forces; he said that the revolutionary intelligentsia should use the weapon of ridicule against it: "we will laugh at them". Canosa, like Maistre, had been quick in resorting to the same weapon against the Jacobins. But the masterpiece of counter-revolutionary and anti-liberal satire are probably Leopardi's dialogues. The *Dialogues* had six reprints in three months; they were praised by Canosa, and (allegedly) by the Pope himself[77]. One of the most famous dialogues is *Pulcinella's Travel* (*Il viaggio di Pulcinella*) which inspired a large production of popular prints in Naples. Indeed Pulcinella is the traditional Neapolitan mask-character, who represented —in the *teatro dell'arte*— the simple-minded but resourceful Neapolitan "low people". In Leopardi's piece Pulcinella (common sense) and a Doctor (the liberal intellectual) discuss the establishment of a constitutional government in Naples. The Doctor explains to Pulcinella that the King of Naples is an absolute king.

> *PULCINELLA*: [...] What does it mean absolute king?
> *DOCTOR*: It means that he rules according to his own will, without depending on anyone else.
> P: What a mess! But tell me one thing. The shoemaker rules in his shop, the host rules in his tavern, the head of the house rules in his family, and why should the king not rule in his own kingdom?
> D: He can rule, but according to the laws.
> P: This is right. I understand. Justice for everyone. But tell me, *signor* Doctor, does not the king of Naples rule exactly like this? He makes laws, and he rules according to them. When the laws are not good anymore, he makes new laws, and again he rules according to them.
> D: And this is precisely what is wrong.
> P: Why?
> D: Because the king should not make the laws.
> P: Why?
> D: Because he is not the sovereign.
> P: The Devil! And who's the sovereign if not the king?

D: The people.
P: That's the best one. And the people didn't know it?
D: We used to live in ignorance.[78]

In a truly "natural" society political constitutions are —at best— useless. Everything is indeed already regulated in the most natural way, i.e. according to tradition. A father does not need a set of abstract rules to govern his own family; similarly a king does not need a constitution to govern his own country (note that a patrimonial conception of the state is taken for granted). Constitutions are always presented by Leopardi and Canosa as artificial, imposed from the outside, extraneous to the specific traditions and to the natural inclinations of the people. When they are forcefully introduced, they act as diseases on the organic body of society (so Leopardi's Pulcinella regularly mistakes the word "constitution" for "constipation"). The crucial theme is that of sovereignty: the king, according to Canosa and Leopardi, cannot be subject to any law —not even his own. In fact, he himself is the source of sovereignty. It follows that a constitutional system leads to paradoxical situations: if sovereignty resides in the throne, the king is subject to his own laws (which is considered absurd); if the sovereignty resides in the people, then the king is reduced to a mere representative figure and the principle of authority is fragmented, with consequences that can only be disastrous for the stability of society. As argued by the sensible Pulcinella, laws are mere contingent instruments the king uses to rule his kingdom. It is moral corruption which prevents modern philosophers from recognizing in nature and tradition the basis of the feudal setting, Leopardi argues. If only they looked at the empirical world without the glasses of their own artificial systems, they would recognize such natural principles, which are the basis of every "organic" society. In fact, the "two books of the Lord" —scripture and nature— teach mankind the very same principles[79].

Leopardi's exemplary anti-liberal campaign was that against the introduction of the nursery school in the States of the Church. Nurseries are considered instrumental to the goals of the liberal forces: they detach the process of education from the family and from the Church in order to suffocate the natural tendency to religion and to the subjection to parents and public authority. Nurseries infuse a "moral of rebellion and pride". As a Neapolitan reactionary author wrote: "that of the parents upon their sons is the most ancient authority, and the purest image of the supreme authority of God; so that in the Scripture parents are called *the visible Gods of their family*"[80]. Thanks also to Leopardi's campaign, nursery schools were forbidden, in the States of the Church, in 1837.

The anti-modern world Leopardi was fighting for was a fanciful world of quiet peasants and laborious artisans living around the manor of their good feudal master, under the unifying wing of Catholic Church. This looks very much like the idealized version of his own small town, Recanati, in the rural province of Marche. Most of Leopardi's energies were indeed devoted to the study of local traditions and of local history. Any innovation threatening the traditional assets of his small *patria* was decidedly opposed in his writings: this held for the introduction of a general land register as well as for the construction of the railway. And one must admit that in his rough but lucid reasoning Leopardi individuated correctly some of the social consequences of administrative and technological innovations (whereas in the liberal literature they are presented as "natural progress"). He also realized that his town had entered an irreversible process of decline, as it was outside the new lines of economic development. Interestingly, Leopardi participated in the political life of his town during the revolution of 1831. Far from being a revolutionary, he saw in the new local government an example of those aristocratic intermediate bodies which he had always praised. Here, together with other landlords, he acted like "a medieval Count", as —in the words of his biographer— he "hoped for the restoration of the *Guelfo* Commun [which means that] he would found a local university, close the old borders of Recanati, provide it with proper administrative structures in order not to depend on the town of Macerata, and finally he would have built around it a Chinese Wall"[81].

The biographical data of Leopardi and Canosa are significantly similar. They spent their youth in the magnificence of the *ancien régime* feudal aristocracy. Then, in the 1790s, they saw the ruin of the patrimony of the family, due to the crisis of the traditional absentee administration of land, the inability to shift to a new model of production, the anti-feudal laws and, finally, the French occupation. Canosa and Leopardi had direct experience of that feudal-communal system they defended so vehemently. Their fathers had been in fact feudal masters ruling over huge estates, and over entire towns. But what is most interesting is the influence their writings had upon an entire generation of educated readers who had certainly never experienced any similar feudal form of life. The dimensions of their editorial success means that, after the Jacobin revolutions of the 1790s, the atmosphere was particularly receptive for such reactionary themes; themes which, as Canosa tell us, were not at all popular in Naples in the late 1780s.

Reactionary Catholicism elaborated a complex re-invention of that very tradition on which it based the authority of its claims. In fact, as has been shown by Mannheim with regard to early German conservative thought, for these authors the present situation acquires its real meaning from the past. The present social setting is given its "sense" by showing how it naturally emerged during the centuries, to assume its present form. To be the product of a historical process is to be justified, it is to be "natural", and this holds for the rights of the feudal landlords, as well as for the dogmas of Catholicism. So Leopardi derided the "pseudo-scientific" arguments employed to demystify a certain miracle, and he justified his belief by means of the antiquity (i.e. authority) of the popular tradition[82]. But what is the "past" that reactionary authors looked at? "Natural" social and political institutions are invariably rooted in the Middle Ages, which is regarded as the golden age of humanity. The knowledge (or better "wisdom") on which such institutions are founded is much more ancient: it coincided indeed with the pre-Greek *philosophia perennis* or *prisca sapientia*[83]. Still, it was in the organic Christian society of the Middle Ages that this wisdom was best expressed by the socio-political and cultural setting. The modern epoch, since the Renaissance onwards, is portrayed as afflicted by an increasing moral corruption, whose direct outcome is a social, cultural and religious fragmentation and decadence. Modern history is the history of the dissolution of the medieval organic society and of its unitary Catholic culture into a set of artificial political and cultural creations. Political reforms, which characterized the eighteenth century, came directly from the minds of "arrogant" philosophers, who thought they had penetrated the secret laws of the universe, and imposed their fantastic creations (*romanzi*) upon empirical reality. What they considered as universal values and laws, are merely the artificial products of their own minds.

The idea of an ancient wisdom is used to link the present institutions to a mythical past, from which they derive their meaning and their authority. The invention of such a continuous and consistent tradition is performed at the expense of the much praised historical sensibility of the reactionaries, who accomplish an impressive simplification of the cultural history of the West, and the attribution of a univocal "meaning" to the whole modern age. Furthermore their image of the Middle Ages as a world crystallized in its perfect structures has nothing to do with the dynamic and confrontational medieval society as described by modern historiography.

Reactionary authors refused to recognize the substantial social mutations that occurred in the eighteenth century. This period had seen a conspicuous rise of the population in the Italian states, and the expansion of a new kind of trading and landed middle-classes, emerging from the groups of small-landowners, lawyers, and administrators of feudal land. In the Northern states, characterized by a more advanced economy, the most dynamic classes were the "enlightened" landed aristocracy and the landowning bourgeoisie, who began to directly manage their properties by breaking with the tradition of the absent feudal landlord. In general, the political structures of the *ancien régime* states were unable to guarantee the interests of these groups, as the failure of the enlightened absolutist policy of the late eighteenth century testifies. Even the most centralized and efficient monarchies, in spite of fighting the feudal power of landlords and of the Church, were unable to accomplish radical administrative and economic reforms. As Hobsbawm underlines, in spite of all the reformist projects announced in the *siècle des lumieres*, "what *did* abolish agrarian feudal relations all over Western and Central Europe was the French Revolution, by direct action, reaction or example, and the revolution of 1848"[84]. Against the background of the social tensions which characterized the life of the Italian states during the whole century (impoverishment of peasants, absolutist ambitions of the monarchies, aristocratic reaction, new landed interests of the bourgeoisie) the idyllic descriptions of the *ancien régime* offered by Canosa and Leopardi show their fictitious and mystifying nature. According to Canosa, the French had occupied and destroyed "a kingdom which was an earthly paradise"[85]. As in the Neapolitan views of the Romantic "Posillipo School", the countryside is represented by reactionaries as a bucolic landscape, rich in natural beauties and in peasants wearing traditional clothes, happily engrossed in their agricultural work, or resting in the shade of Roman and medieval monuments. The perfect organic Christian society of the Middle Ages, which followed the natural inclinations of human beings and gave to their lives the fullest meaning through the respect of a transcendent hierarchical order, became, in the eyes of Canosa's and Leopardi's readers, an idyllic image to oppose to the "materiality" and "violence" of modern liberal society. At the waning of the last remains of the feudal world, its idealization became a diffused and powerful ideology, the only one which (together with contemporary Catholic thought) seemed able to counteract the democratic and liberal systems.

4.6 Theological Reaction: from the Counter-Revolutionary Crusade to the Neo-Scholastic System

In the mid-1830s aristocratic Reactionary Catholicism entered its final and declining period. By that time, liberal Catholicism was emerging as the religious ideology of Italian bourgeoisie; on the opposite side, the intransigent clergy had been elaborating a much subtler theoretical position to fight liberalism and reformism, leaving behind the embarrassing and Gothic apparatus of French Traditionalism and Reactionary Catholicism: Neo-Scholastic philosophy. Naples was the birth place of Neo-Scholasticism[86]. Indeed, if Canosa was the most well-known secular representative of aristocratic Reactionary Catholicism, the Theatin Gioacchino Ventura was certainly the most authoritative exponent of ecclesiastic Reactionary Catholicism in Italy, and he was to be one of the fathers of Neo-Scholastic philosophy.

In 1821 Ventura founded in Naples the first and most lively ultramontane periodical: *The Ecclesiastic Encyclopedia*[87]. His aim was to refute the French encyclopedic and reformist culture, and to offer an alternative system of knowledge on which political reaction could be founded (a "new counter-revolutionary encyclopedia" Ventura called it). The articles are unified by a clear reference to Lamennais, of whom Ventura was a personal friend. Ventura also linked his work to the preexisting Italian reactionary culture; so that he contacted Canosa for advice and contributions, and established solid links with the ultramontane groups of Turin and Modena. Ventura's primary goal was immediately political: the reconstruction of society according to traditional Catholic values, moving from the only "sane" components left: people and legitimate kings. The enemy was the liberal elite who asked the king for a constitution and a free-trade economy. The ideological construction behind Ventura's articles is rather simple: rejection of the secularized culture of the eighteenth century and a new foundation of culture and society on Catholicism. One finds the familiar themes of the revolution as the product of a minority, and of its schismatic nature. The Reform is described as a rebellion against the Roman Church in the name of individual reason[88], whose consequence was that of dissolving society, since the Church is crucial to maintaining social order[89]. Consequently, being liberal, pro-constitution or Jansenist is one and the same thing[90]. Religious tolerance is only a sign of religious indifference[91]. Sovereigns are criticized for their anti-ecclesiastic and anti-feudal policy during the late eighteenth century: the Church must have supremacy over civil power. New emerging classes are portrayed as "a crowd of new men emerging from the mud"; they are the egoistic and materialist bourgeois who aim to found society on profit. The remedy advanced by Ventura is the supremacy of religion in every aspect of social and cultural life, on the infallibility of the Pontiff, on the priority of society over the individual, "of the whole over the part"; and on society being founded on subjection to authority[92]. Other themes treated by Ventura include social contracts, which cannot exist because they would imply the independence of man from God (in fact, the social contract, guaranteed by unstable individual interests, is ultimately based on materialism and atheism[93]). The expansion of trade, and the "full property" of land are also opposed, as they "nourish human cupidity"[94]. Religious censorship is defended[95], for all works which could provoke "social envy"[96]. Freedom of the press is "the greatest plague of the century"[97]. Modern didactic methods bring rebellion into the schools[98], as state universities do[99]. The "happy state" of the pre-revolutionary age is frequently and nostalgically eulogized[100] (but consider that Ventura was born in 1792). Ventura thought that conceding one single point to the enemy would destroy the whole building of Reactionary Catholicism[101]. His was a dramatic ideology: the barriers were continuously being assaulted, and without doubt, no compromise with the corrupting principles was possible at all.

In 1820 Lamennais had published the second volume of his famous *Essay on Indifference*. His theory of common sense is articulated and opposed to the individual reason of the philosopher, who "refuses to receive his reason from society and mankind, to believe on the basis of their testimonial and authority; similarly the heretic refuses to receive the scripture from the hands of the Church, to believe on the basis of its testimonial and to submit his interpretation to its authority"[102]. Certainty cannot be reached by individual reason (through reasoning and perceptions); it can only be *received* from society and ultimately from the supreme authority of God. Ventura, who was a member of the Commission for Public Education and a royal censor, preached the doctrine of common sense in Naples with great enthusiasm[103].

The fundamental goal of Ventura, as of the reactionary groups of Turin and Modena, was to oppose a new, Catholic Encyclopedia to the revolutionary one, showing how every branch of human knowledge can be grounded on Catholicism, as opposed to sensationalist philosophy. From this perspective, philosophy coincides with religion, and the individual is organically connected to society, so that the possibility of individual reason being creative about social order is ruled out *ab initio*. Now, Lamennais' theory of common sense and Bonald's social theory of language had been crucial resources for Reactionary Catholicism in the years of the "emergency" (mid-1790s to the restoration); but they were soon perceived as philosophically inadequate by the Italian reactionary clergy. Moreover, from the mid-1820s Lamennais began to diverge from the Roman orthodoxy, as he disagreed with the "diplomatic policy" of the curia.

Neo-scholasticism was elaborated precisely by those men who, a few years before had been Lamennesian, and Ventura was among them. Fontana wrote that "Thomism was the Italian version of Traditionalist philosophy"[104]. In fact, the re-elaboration of the Scholastic tradition accomplished the ambitious project which had been originally expressed by Traditionalists and Reactionary Catholics: that of presenting a Catholic encyclopedia, an organic system of knowledge to oppose to the modern one. There was an important reason why Lamennais could not agree with the restoration of Scholasticism. In his mind, after the demolition of the pretenses of individual reason and of all the philosophical systems, there was no need for a rational foundation of religious belief. His sociological considerations and the principle of authority were all he needed to ground his theocratic conception of society. This was certainly not the view of the Jesuits and of the Holy See. In Italy, the battle of Traditionalism was seen as naturally linked to the rediscovery of Thomas Aquinas; the concerns about social order which lie behind Neo-Scholastic thought are exactly the same as those of the early reactionaries. "It is impossible" wrote one of them, "that someone who has studied Saint Thomas would become a revolutionary"[105]. This situation makes sense of the oscillations of Italian Reactionary Catholic authors between the conception of the absolute impossibility of founding religion on reason (*à la* Maistre or Lamennais), and the attempt to do that, maybe adducing pseudo-mathematical proofs. The Italians (and the Neapolitans in particular) appeared not to see any contradiction in their own writings, where Neo-Scholasticism and theory of common sense are indeed presented as compatible. Another Neo-Scholastic wrote that "Aristotelian philosophy was in fact common sense transformed into philosophical method"[106]. Religious belief and common sense are identified *tout court* with Neo-Scholastic philosophy.

In fact, the best example of the Traditionalist interpretation of Aristotelian philosophy is provided by Ventura, who was at once the most authoritative follower of Lamennais in Italy and the most convinced restorer of the Scholastic system of knowledge. His *De methodo philosophandi* (1828) was devoted to this cultural operation[107]. Ventura argued that the present religious indifference was not the result of some sort of ignorance, or of the progress of the sciences; it was instead the consequence of the specific methodology of modern philosophy. In the past, Ventura remarked, many different methods were employed to study different kinds of realities: in theological matters the principle of authority was adopted; in moral and social matters the method of common sense; in the natural sciences the empirical method. The goal of modern philosophers and of Neapolitan reformers has been directed to remove such differences, and to reduce the many methodologies to a single, absolute methodology. All sciences are placed at the same level, destroying the traditional hierarchy, and everywhere empirical method is adopted. The result is that philosophers pretend "to discover the truth" even in fields where they previously used to "explain appearances". The absolutization of the empirical method makes it necessary that only natural truths can possibly be known. But this is to deny the very essence of Christianity, which is founded on revealed, super-natural truths. From here stems the spread of irreligiosity, moral subversion and ultimately, social subversion. This is the core of Ventura's argument; it is in fact an original re-elaboration of the themes of French Traditionalism, where the methodological and epistemological dimensions emerged as the crucial ones, and the methodological plan is precisely where the connection with scholasticism is made. In the previous part, I described how the work of Neapolitan reformers and analytics is best understood in terms of an epistemological shift towards a unitary methodology based upon sensationalistic philosophy, and with the goal of excluding religion and metaphysics from the realm of legitimate knowledge. Now I suggest that precisely this shift is the phenomenon studied by Ventura in his Latin book, and it is against this shift that his action was directed.

Scholastic philosophy is presented by Ventura as one and the same thing as Lamennaisian common sense[108]. The principle of scholasticism is the "substantial unity" of every reality; so for instance man is an indissoluble composition (*compositio*) of body and soul; whereas "recent philosophy" attributes certainty only to sensations (impressions of the soul)[109]. Ventura refers here to the substantial unity of "form" and "matter" in Aristotelian philosophy. By analogy, it is only the unity of "truth" and "intelligence" (reasoning) that can bring about the unity of human reason. Where modern philosophers pretend to discover the truth by their own reasoning and to found the unity of man on a sensationalistic basis, in scholasticism it is the contemporaneous presence of pre-existent truth and human reasoning, of body and soul, that produces legitimate knowledge. By analogy, one can claim – as Ventura did – that in social and political order the unity derives from the substantial union of state and Church ("unio substantialis inter Ecclesiam et Statum")[110].

Needless to say, Ventura's reading of Thomas Aquinas is highly disputable[111]. But that is not the point here. The point is rather to note the ideological aim of rejecting the secularization of the state and the secularization of knowledge by appealing to the authoritative thought of Aquinas. By appropriating Scholastic thought, the "counter-revolutionary encyclopedia" took a most important step; the original irrationalist response was indeed replaced by an omni-comprehensive scheme, a well-structured system of knowledge where conceptual tools could be found to deal with any kind of matter and problem. The general orientation – total opposition to modern thought, political liberalism and social reformism – was to remain unaltered[112]. One of the crucial moves is to define human reason as a merely "explicative" —as opposed to "creative", "investigative"— faculty. This is an exemplary case of a mixture of a Traditionalist theme (the weakness of human reason) and a Thomistic one (that of human reason as a "mirror" of external reality). Ventura himself made clear, in another context, the improvements offered by Neo-Scholasticism with respect to French Traditionalism; among them, the definition of human being,as given above, to replace Bonald's definition; and the epistemological doctrine of Thomism to replace Maistre's innate ideas. Ventura thought that the foundation of certainty provided by Lamennais (common sense) is indeed the same thing as Thomism, but he considered the latter a more solid and profound doctrine. In the end, Ventura said, scholasticism is the system upon which the principle of authority so well presented by Traditionalists can be philosophically founded, providing a definitive confutation of the possibility for the "private sense" (i.e. the individual reason) to know something with certainty[113].

Scholasticism provided Ventura with a solution for the pressing problem of the substantial unity of state and Church, human reason and reality, thus enabling him to refute *ab initio* any dangerous social or epistemological autonomy and any possible subversive use of reason. It also gave an important impression of continuity with the previous tradition of the Catholic Church. At the Second Vatican Council (1870), Neo-Scholasticism was to be recognized as the official philosophy of the Catholic Church. The theory of common sense was to gradually disappear as an autonomous doctrine about certainty, particularly after the Pontiff condemned Lamennais (1832) —as the French abbé was turning his doctrine into an instrument to subvert the authority of Rome. However, the major point of Lamennais's position remained crucial to Neo-Scholasticism —namely the negation of any "inquisitive" capacity of reason and its characterization in terms of explicative and deductive capacity with regard to revealed truths. According to Neo-Scholasticism, the assent of reason to "primary truths" is immediate and intuitive. It is not just an act of faith, of respect for authority, but "an act due to nature, which imposes those truths, without any proof, to any healthy intellect, as it lets any healthy eye see daylight without the mediation of another light to make it visible"[114].

In Ventura's *Encyclopedia* we find also important traces of another component of this more advanced form of Reactionary Catholicism: the work of Karl Ludwig von Haller on the science of the state[115]. Haller's book was carefully studied by Ventura, and his conversion to Catholicism was also proudly advertised. We do not need to delve into Haller's theory here: only to note that his main aim was to refute any contractualist foundation of the state. To this extent Haller did not employ the religious and philosophical arguments of Traditionalism; rather he kept his analysis at a very specific and empirical level, deducing "scientifically" from observations his authoritarian conception of power, where sovereignty is sanctioned by the superiority of certain individuals over others. In Italy, Haller was presented by reactionaries as a martyr of science and religion, as a proof of the fact that Catholicism did not conflict with science, and that a scientific theory of power supports the necessity of Catholicism as a stabilizing factor. This reference to Haller, together with the re-discovery of Aquinas, reveals the concern for "scientific forms" of knowledge among Reactionary Catholic authors. And it is indeed time to concentrate precisely on the position of scientific knowledge in the context of the anti-encyclopedia of Reactionary Catholicism.

Notes to chapter four

[1] Amodeo, *Vita matematica napoletana*, vol.2, p.141.

[2] On the anti-modern tendencies of the Roman Church in the second half of the eighteenth century, see Daniele Menozzi, "Tra riforma e restaurazione: dalla crisi della società cristiana al mito della cristianità medivale, 1758-1848", in *Storia d'Italia, Suppl.9: La chiesa e il potere politico dal medioevo all'età contemporanea* (Turin: Einaudi, 1986) pp.767-806; and Daniele Menozzi, "Intorno alle origini del mito della cristianità", *Cristianesimo nella storia*, 1984, 5:523-562.

[3] On the "Christian Friendships" see Candido Bona, *Le "Amicizie": società segrete e rinascita religiosa,1770-1830* (Turin: Deputazione Subalpina di Storia Patria, 1962).

[4] The theory of the occult philosophical-freemason conspiracy enjoyed a great success among conservative authors all over Europe. It first appeared in Antoine de Ferrand, *Les conspirateurs démasqués par l'auteur de "Nullité et despotisme"* (Turin: 1790), and found its most famous elaboration in Augustine Barruel, *Mémoires pour servir à l'histoire du Jacobinisme*, 5 vols. (London: 1797); translated in Italian in 1799.

[5] Nicola Spedalieri, *I diritti dell'uomo, libri VI, nei quali si dimostra che la più sicura custodia de' medesimi nella società civile è la religione cristiana, e che però l'unico progetto utile alle preseneti circostanze è di far rifiorire essa religione* (Assisi[Rome]: 1791).

[6] Pietro Tamburini, *Lettere teologico-politiche* (Pavia: 1794).

[7] Salvatorelli observes that Tamburini's book is a proof of the theoretical distance between Jansenist theology and revolutionary and liberal theories. It is a matter of fact, he recognizes, that Jansenism opposed the "papal absolutism", and that many Jansenists took part in the

Jacobin insurrections. Nevertheless, Tamburini's book is "a monument of absolutist thought", "the more noteworthy affirmation of the Italian anti-revolutionary thought in the period of Revolution". See Luigi Salvatorelli, *Il pensiero politico italiano dal 1700 al 1870*, p.110.

[8] Quoted in Giorgio Candeloro, *Storia dell'Italia moderna: Le origini del Risorgimento* (Milan: Feltrinelli, 1989) pp.168-169.

[9] Sandro Fontana, *La controrivoluzione cattolica in Italia, 1820-1830* (Brescia: Morcelliana, 1968) p.13.

[10] On the phenomenon of the popular missions in France see: Ernest Sevrin, *Les missions religiouses en France sous la restauration*, 2 vols. (Paris: Vrin, 1948).

[11] Edgar Hocedez, *Histoire de la thèologie au XIXe siècle*, 3 vols. (Bruxelles: L'Edition Universelle, 1949) vol.1, pp.72-91.

[12] [Joseph de Maistre], *Lettres d'un royaliste savoisien* (Lausanne: 1793) p.39.

[13] Maistre, *Lettres*, p.166.

[14] Joseph de Maistre, *Considérations sur la France* (Lausanne: 1796) p.69. English translation by Richard Lebrun, *Considerations on France* (Cambridge: Cambridge U.P, 1994).

[15] Quoted in Marco Ravera, *Introduzione al Tradizionalismo francese* (Bari: Laterza 1991) p.22.

[16] Joseph de Maistre, *Essai sur le principe générateur des constitutions politiques et des autres institutions humaines* (Paris: 1814) p.344.

[17] Ibidem, p.358.

[18] Maistres, *Lettres*, p.154.

[19] "Il existe une seule constitution de société politique, une seule constitution de société religieuse: la réunion de ces deux sociétés constitue la société civile; l'une et l'autre constitution résultent de la nature des êtres qui composent chacune de ces deux sociétés, aussi necessariement que la pesanteur rèsulte de la nature des corps. Ces deux constitutions sont nécessaires dans l'acception métaphysique de cette expression [...]: ainsi toute société religieuse ou politique qui n'est pas encore parvenue a sa constitution naturelle tend necessairement à y parvennir: toute société que les passions de l'homme ont écartée de sa constitution naturelle tend necessairement ày revenir" (Louis de Bonald, *Theorie du Pouvoir*, quoted in Fontana, *La controrivoluzione*, p.38).

[20] Ibidem, p.39.

[21] Louis de Bonald, *Essai analytique sur les lois naturelles de l'ordre social* (n.p.: 1800) pp.49-50.

[22] Ibidem, p.363.

[23] Bonald *Recherces philosophiques sur les premiers objets des connaissances morales*, 2 vols. (Paris: 1818) vol.1, p.69.

[24] Ibidem, pp.303-16.

[25] See Fontana, *La controrivoluzione*, p.45.

[26] Félicité de Lamennais, *Essai sur l'indifférence en matiére de religion*, 4 vols. (Paris: 1817, 1820, 1823, 1824) vol.1, p. xxix-xxx.

[27] Ibidem, vol.2, pp.3-34.

[28] See Félicité de Lamennais, *De la religion considérée dans ses rapports avec l'ordre politique et civil*, 2 vols. (Paris: 1825, 1826).

[29] Luigi Salvatorelli, *Chiesa e stato dalla rivoluzione francese ad oggi* (Florence: Le Monnier, 1955) p.5.

[30] Fontana, *La controrivoluzione*, p.57.

[31] Ibidem, p.69. On the condition of the church in the Italian states after the Restoration, see also Guido Verucci, "Chiesa e società nell'Italia della Restaurazione", *Rivista di storia della Chiesa in Italia*, 1976, 30:25-72.

[32] Ibidem, p.106.

[33] On the library of the Oratorio see Antonio Bellucci, "La biblioteca dei Girolamini di Napoli", *Accademie e biblioteche d'Italia*, 1930, 4:38-64.

[34] See Elvira Chiosi, *Lo spirito del secolo*, p.38.

[35] Ibidem, p.40.

[36] See Giovanni Camillo Rossi, *Dottrina di Gesù Cristo sulla chiesa, sulla grazia e sulla sovranità* (Naples: 1794).

[37] Also important for the elaboration of Reactionary Catholicism in Naples was the Christian Friendship founded in 1779. It diffused a Jesuit form of Christianity, based on the infallibility of the Pontiff, popular devotions, and a probabilistic approach to morals.
[38] On the activity of the Royal Arcadia see Chiosi, *Lo spirito del secolo,* pp.233-264.
[39] On the Catholic critique of the "egoist bourgeois" in late eighteenth-century France, see Bernard Groethuysen, *The Bourgeois: Catholicism versus Capitalism in 18th Century France* (London: Barrie and Cresset, 1968).
[40] Later Canosa blamed the "violent and unjust provisions of the revolutionary usurpers" for his own ruin. He argued that the anti-feudal legislation was not only the product of an illegitimate sovereign, but it was also illegally applied to his own case, given that he was born well before the abolition of majorat and fidei-commissum. See Canosa, *Epistola, ovvero riflessioni critiche sulla moderna "Storia del Reame di Napoli" del generale Pietro Colletta* (1834), entirely reprinted in Silvio Vitale, *Il principe di Canosa e l'epistola contro Pietro Colletta* (Naples: Berisio, 1969) pp.183-184.
[41] Canosa, *Osservazioni anatomiche sopra le parti del corpo umano e sopra le funzini che dalle medesime si perfezionano,* manuscript conserved in the private archive of the Capece Minutolo in Naples. See Vitale, *Il principe di Canosa,* p.33.
[42] Quoted in Vitale, *Il principe di Canosa,* p.14.
[43] Walter Maturi, *Il principe di Canosa* (Florence: 1944) p.2.
[44] Canosa met them both in Rome in 1795.
[45] He has been attributed with the anonymous *Disinganni nelle parole ai popoli della Europa tutta* (n.p.: 1797). Borgia was the secretary of the Congregation of Propaganda Fide from 1770, and he actively supported the missionary movement. He favored the survival of the Society of Jesus in Russia after 1773. From 1796, he was prefect of the Congregation of the Index. He was in charge of public order during the difficult days of the French occupation. For a profile, see *Dizionario biografico degli italiani,* sub voce.
[46]Augustin Barruel (1741-1820). A French Jesuit, he left France for Austria after the expulsion of the Society. He was back in France in 1774, to begin a polemical confrontation with the *philosophes.* He wrote for the *Journal Écclésiastique.* He was forced to leave France in 1792, and to remain in England for ten years. Here he published his main works. Great enemy of the eighteenth century, he published his *Mémoires* in London (1797), then in Paris (1803: the same year of the Neapolitan edition).
[47] Barruel, in his *Memoires,* recognized three interconnected conspiracies: the first one against Christianity, the second one against the monarchies; the third one against any form of society and property. The crucial point of his conspiracy theory is that the Revolution was the result of the action of a restricted group of occult conspirators. This enabled Barruel to take a further step and to argue for the essential uniformity of the modern revolutionary phenomena which, in spite of all the "superficial", local differences, are caused everywhere by the same obscure, freemason forces, and follow a common subversive design. In this way the French Revolution can also be assimilated to previous "rebellions" against legitimate civil and religious authorities, such as the Protestant Reform and the anti-religious campaign of seventeenth-century libertines, and the campaign of the eighteenth-century *philosophes.* Common denominator of these rebellions is the moral corruption of a minority, which spread all over society as an epidemic (the most frequently used metaphors are indeed those of plague and cholera). Note that the origin of such a moral corruption was the belief that individual reason could be taken as a supreme criterion to discriminate between truth and falsehood, good and evil.
[48] Canosa wrote of few "invisibles" (freemasons), who are behind every single revolution (see, for instance, Canosa, *Epistola,* p. 181).
[49] Canosa, *Epistola,* p.101.
[50] The political alliance with Rome had immediate effects on the Neapolitan culture. The last reformist texts appeared in early 1794, while 1796 saw the "crusade" against reformist culture, which included public burnings of books (amongst the most burned were Filangieri and Pagano). Any theological position diverging from the Roman orthodoxy (including Jansenism) was repressed as politically inconvenient and theoretically dangerous.

Intransigent bishops were given dioceses all over the kingdom, and the streets of Naples were named and numbered, in order to facilitate police operations.
[51] Canosa, *La trinità* (Naples: 1795). The book was dedicated to Cardinal Borgia; the text had been originally read in a Neapolitan church in August 1795 (see front page).
[52] Canosa, *Trinità*, p.36.
[53] Canosa, *Trinità*, p.79.
[54] Canosa, *Trinità*, p.73.
[55] Canosa, *L'utilità della monarchia nello stato civile* (Naples: 1795). It was another academic dissertation, and was later read at the Royal Arcadia (June 1796). The second edition (Naples: 1796) was dedicated to Cardinal Borgia (quotations are from the second edition).
[56] Montesquieu, *Lo spirito delle leggi* (Naples: 1771) edited by Antonio Genovesi.
[57] Canosa, *Utilità*, p.8.
[58] Canosa, *Utilità*, pp.50-51.
[59] See Vitale, *Il principe di Canosa*, p.26.
[60] Nicola Vivenzio, *Del servizio militare dei baroni in tempo di guerra* (Naples: 1796). Briefly, it was another question of taxes. War with France was in sight, and the Crown was looking for quick money and, in line with the traditional anti-feudal policy, its magistrates hit feudatories particularly hard by reviving ancient military obligations. Canosa claimed that the "recent feuds" had been given by the king without the obligation of military service – which was instead included in the "ancient feuds" (roughly, those given before the fifteenth century). The king's demand for these services (which had been meanwhile transmuted into taxes) from the owners of recent feuds was then illegal.
[61] See Maturi, *Il principe di Canosa*, p.13.
[62] Ibidem, p.26.
[63] Canosa, *Memoria dilucidativa di vari articoli da aversi in considerazione nella abolizione da farsi dei feudi e della feudalità, del cittadino Antonio Capece Minutolo* ([Naples]: [1799]). Note that Canosa is now a "citizen".
[64] Canosa, *Memoria*, p.16.
[65] Canosa, *La passione e morte del Divino Nostro Redentore* (Naples: 1802); and Canosa, *La natività del nostro Divino Redentore* (Naples: 1802).
[66] On this pamphlet, see Vitale, *Il principe di Canosa*, p.33.
[67] Canosa, *Discorso sulla decadenza della nobiltà*, manuscript; quoted in Maturi, *Il principe di Canosa*, pp.38-40.
[68] Tommaso Maria Mamachi (1713-1792). From 1740 he was professor of physics at the University La Sapienza in Rome, and consultant of the Congregation of the Index; between 1742 and 1785 he directed *The Ecclesiastical Journal of Rome*. He was a zealous supporter of the Roman Pontiff, and a personal enemy of Antonio Genovesi.
[69] See Maturi, *Il principe di Canosa*, p.39.
[70] Ibidem, pp.34-35.
[71] Number of 18 September 1819.
[72] Canosa, *Epistola*, p.204.
[73] *Della religione considerata nei suoi rapporti coll'ordine politico e civile* (Genoa: 1825).
[74]"We will conclude these lessons of philosophy, recognizing [...] that society cannot subsist without a supreme authority which rules and governs it; that men enter society with the duty of subjection, not with the right to liberty; that men are born with different physical strength, health, intelligence, that is to say in the natural inequality, from which it necessarily derives civil inequality; [...] that covenants and constitutions established by men cannot alter the principle, or weaken the reasons, of sovereignty, which derives directly from the Divinity; [...] that the same level of instruction and civility for everyone is not beneficial to maintain a stable social order, where men have to live in different conditions and classes; that everyone has to love his country, his government and his state without worrying about the dimension of its borders, and without following the ravings about nationality and national independence promoted by the would-be philosophy" (Monaldo Leopardi, *Cathechismo filosofico* (1832), reprinted in Monaldo Leopardi, *Autobiografia* (Rome: 1883) pp.356-357).

[75] Monaldo Leopardi, *Dialoghetti sulle materie correnti dell'anno 1831* (Pesaro: 1832).
[76] "Another reason for the disorder [*sconquassamento*] of the world is the excessive diffusion of literature, and that itch for literature which has pervaded fishmongers and stablemen. The world certainly needs wise men and literati, but also shoemakers, tailors, smiths, peasants, artisans of all kinds, and it needs a great mass of good and quiet people who are content to live trusting someone else, and let the world be guided by someone else's ideas, without pretending to guide it with their own ideas. For such people literature is dangerous, because it aggravates those minds which are destined by nature to operate in a restricted sphere; it promotes doubts which the mediocrity of their knowledge is unable to solve; it offers those spiritual pleasures which make every day physical work unbearable; it stimulates desires unapt to the humility of their conditions; it makes the people unsatisfied with their fate, and makes them attempt to obtain a different one. [If there was a teacher able to make out of every pupil an Aristotle] he should be immediately killed, to avoid the total dissolution of society" (Leopardi, *Dialoghetti*, pp.85-86). On the success of similar themes in eighteenth-century Britain see the chapter entitled "Cosmic Toryism" in Basil Willey, *The Eighteenth Century Background: Studies on the Idea of Nature in the Thought of the Period* (London: Chatto and Windus, 1980; orig.ed. 1940).
[77] See Mario Themelly and Vito Lo Curto, *Gli scrittori cattolici dalla Restaurazione all'Unità* (Bari: Laterza, 1984) p.14.
[78] Leopardi, *Dialoghetti*, pp.49-50.
[79] Monaldo Leopardi, *Le illusioni della pubblica carità* (Lugano: 1837).
[80] Luciano Liberatore, *L'Italia e la religione cattolica nel 1848 e 1849* (Naples: 1849) p.71.
[81] Giuseppe Piergili, *Notizia della vita e degli scritti del Conte Monaldo Leopardi* (Florence: 1899) p.45.
[82] Ibidem, p.60.
[83] On the origin and diffusion of the doctrine of the *philosophia perennis* see Francis Yates, *Giordano Bruno and the Hermetic Tradition* (London: Routledge, 1964); Charles Schmitt, "Perennial Philosophy: From Agostino Steuco to Leibniz", *Journal of the History of Ideas*, 27:505-532; and Daniel Walker, *The Ancient Theology: Studies in Christian Platonism from the Fifteenth to the Eighteenth Century* (London: Duckworth, 1972). On the fortune of the doctrine in Italy see Paolo Casini, *L'antica sapienza italica. Cronistoria di un mito* (Bologna: Il Mulino, 1998) particularly chapter four, on the Kingdom of Naples.
[84] Erich Hobsbawm, *The Age of Revolution, 1789-1848* (London: Abacus, 1995) p.37.
[85] Canosa, *Epistola*, p.136.
[86] See Amato Masnovo, *Il neotomismo in Italia* (Milan: 1923); and Pasquale Orlando, *Il tomismo a Napoli nel sec. XIX. La scuola del Sanseverino* (Vatican City: Pontificia Università Lateranense, 1968).
[87] On this periodical see Fontana, *La controrivoluzione*, pp.86-105.
[88] *Enciclopedia ecclesiastica e morale*, reprinted by Francesco Procopio (Naples: 1864), p.130.
[89] Ibidem, p.510.
[90] Ibidem, p.486.
[91] Ibidem, p.19.
[92] Ibidem, p.491.
[93] Ibidem, p.492-94.
[94] Ibidem, p.516.
[95] Ibidem, p.14.
[96] Ibidem, p.197.
[97] Ibidem, p.66.
[98] Ibidem, p.66.
[99] Ibidem, p.516.
[100] Ibidem, pp.22-23, for instance.
[101] Ibidem, p.518.
[102] Ibidem, p.143.
[103] See his letter to the Archbishop of Naples, reprinted in Fontana, *La controrivoluzione*, pp.142-144.

[104] Ibidem, p.161.
[105] Quoted in Fontana, *La controrivoluzione*, p.169.
[106] Quoted in Fontana, *La controrivoluzione*, p.172.
[107] Gioacchino Ventura, *De methodo philosophandi* (Rome: 1828).
[108] Ibidem, p.xlvi.
[109] Ibidem, p.xlii.
[110] Ibidem, p.lxxxvi.
[111] See, for instance, the critical remarks in Anna Cristofoli, *Il pensiero religioso di P.Gioacchino Ventura* (Milan: 1927) p.123.
[112] The substantial continuity between the goals of Reactionary Catholicism and of mid-century Jesuit Neo-Scholasticism has been pointed out in Louis Foucher, *La philosophie catholique en France au XIXme siècle avant la Renaissance thomiste et dans son rapport avec elle, 1800-1880* (Paris: Vrin, 1955) p.252.
[113] See Gioacchino Ventura, *Osservazioni sulle opinioni filosofiche dei Sig. de Bonald, de Maistre e de La Mennais e Laurentie all'occasione di un articolo del giornale francese "Il Corrispondente"* (Rome: 1829) pp.3-23.
[114] So went the Neo-Scholastic Jesuit Luigi Taparelli d'Azeglio in his "Di due filosofie", *Civiltà Cattolica*, 1853, 1, p.484.
[115] Karl Ludwig von Haller, *Restauration des Staats-Wissenschaft*, 6 vols. (Winterthur: 1816-1834). Translated in Italian by the editors of the Neapolitan periodical *Biblioteca Cattolica*, as *Ristaurazione della scienza politica* (Naples: 1826).

Chapter Five

The Knowledge of Reaction: Philosophy, Science and Mathematics

5.1 Reactionary Philosophy in Naples

The reactionary turn of the Neapolitan government between 1791 and 1793, and its new alliance with the counter-revolutionary powers was followed by a re-orientation of the cultural and educational policy. The emerging reactionary component of the Neapolitan Church was then charged —after years of anti-ecclesiastic policy— with taking full control of the system of education. This momentous event could not leave contemporary philosophical production unaffected. In fact, the turn from sensationalism and *ideology* to forms of eclectic scholastic philosophy was sudden and dramatic. As we have seen, forms of sensationalism surviving with Delfico and his school, were to be revived under the French occupation; but the point is that after 1794 they were decidedly minoritarian. With the suppression of unorthodox private studios and academies, and particularly after "the year of the crusade against culture" (1796), the reactionary intellectual block of the RUN extended its control over Neapolitan intellectual life. The change of intellectual atmosphere from the age of reformism to that of reaction, has been described as "disconcerting": by 1800 "the old Neapolitan cultural environment, that of Genovesi, Grimaldi, Filangieri, Pagano, and Galanti, of the *Lessons on Trade* and of the *Science of Legislation*, is completely unrecognizable"[1]. From 1797 the RUN was the responsibility of monsignor Agostino Gervasio (an ultra-conservative ecclesiastic) and Vecchione (the admirer of Canosa). In Autumn 1799, after the fall of the Neapolitan Republic, their duty was precisely that of "eradicating the dangerous ideas which caused so many disasters". In line with contemporary Reactionary Catholicism, religion was brought to the center of education, as the only remedy against political subversion. In 1804, to reinforce this trend, the Jesuits were re-admitted to Naples, thanks to the diplomatic action of Vecchione. They were then charged with important didactic duties. The second restoration of the Bourbons (1815, after Joachim Murat's defeat and execution) followed a very similar pattern. Through the action of a special commission, Catholicism was put once again at the center of the educational system. Among the members of the commission were Vecchione and a group of Catholic intellectuals: Giuseppe Capocasale, Domenico Cotugno, and Nicola Fergola. Around 1821, reaction reached its political and cultural apogee, with Canosa at the Ministry of Police, Ventura directing the *Ecclesiastic Encyclopedia*, the establishment of a Committee for Public Education, presided over by the Archbishop of Naples, and of special commissions charged with controlling the "moral conduct" of teachers. Meanwhile, in 1816, a chair of Truth of Christian Religion had been created in the RUN, and the chair of Ideology had been replaced by that of Logic and Metaphysics[2].

This last change was indeed representative of the new philosophical culture which was an expression of the power-bloc formed by the Crown and the Church. Philosophical texts of the "official" reactionary culture were invariably based on the late scholastic tradition, and on the systematization of knowledge accomplished by the rationalist philosopher Christian Wolff (1679-1754). Wolff's system was based on the priority of metaphysics over any other form of knowledge, and it was indeed a typical example of the "old way" of doing philosophy criticized by the reformers and the Jacobins (and a polemical target of Gennaro Cestari). In the Wolffian system formal logic was introduced as preparatory to metaphysics; from metaphysics one moves to the theoretical problems of ontology, cosmology, "empirical" psychology, "rational" psychology, and natural theology; and from here to the practical problems of moral philosophy, natural law, ethics, and politics. The system was strongly unitary, tied up in the laces of a few all-pervading metaphysical principles (and, as Cestari noticed, it worked in an essentially circular way). One should notice that there is no separation between theology and metaphysics or religion and politics, and this was what attracted the reactionary philosophers.

Using the textbooks of the late dogmatic rationalism, such as those by Christian Wolff and by his followers Sigismund Storchenau, Friedrich Baumaister, and Paul Mako, the Neapolitan reactionary intelligentsia articulated a curriculum of philosophical studies which suited the new reactionary politics[3]. In 1804, in his opening speech from the new chair of Logic and Metaphysics, Capocasale addressed the audience by explaining that no scientific investigation is possible, in any area of knowledge, without the previous support of metaphysics[4]. In fact, this was the complete reversal of the claims of the reformers. Capocasale's ontology was based on the principle of non-contradiction, which holds for every necessary and contingent truth; a consequence of this principle is that reality is structured according to the most harmonic and teleological order, which emerges particularly in cosmology, whose duty it is to highlight the great cosmic chain of being, the universal and uninterrupted connection (in Latin: *ordo*) of entities[5]. But the "order" of the world is still not enough in itself. The crucial step was that of showing the necessary link between such a universal order (proved ontologically) and the action of a supreme intelligent causal principle which is the end of this teleological chain. The same basic scheme was present in every production of reactionary philosophy in the first three decades of the century. Key points were the necessity of metaphysical foundations for the sciences, the link between ontology and cosmology, the teleological universal chain of beings, whose ordered, proportioned and harmonic disposition reflects God's wisdom[6].

Neapolitan authors in this trend also took into account the important results of the strong sensationalistic and *ideological* trend which came down from Genovesi to the early nineteenth century. The dogmatic treatment of metaphysics did not compromise at all the possibility of accepting empiricist claims when it came to the investigation of reality. Locke, Condillac, Genovesi, Newton were indeed portrayed as models in philosophy, and Capocasale was also the author of a text of Newtonian physics. Empirical researches were easily framed within this metaphysical system, and thus absorbed into the unitary harmony of the system, which was a teleological harmony, depending ultimately on the dogmas of Christian religion. So, for instance, one could investigate the empirical origin of ideas, but this did not affect the metaphysical questions of the existence and immortality of the soul; much of the *ideological* production could be recycled in the new metaphysical perspective[7]. What could not be absorbed was the idea of the "activity" of matter (present in Lauberg and in other *ideologists*). Reactionary philosophers invariably described matter as inert, passive, only possessing the force which is communicated to it from external causes or which is given to it (*praeter essentiam*) from God's will. It should also be noted that, in spite of the possibility of grasping the basic (formal) ontological principles, man cannot "penetrate all the mysteries" and "the most hidden essences and causes" which are in nature; this pretension only produces an ambitious metaphysics, rich in chimeras and human inventions: it is indeed the metaphysics of the *philosophes*[8]. The real and useful metaphysics "confines itself to the right limits given by nature to human intellect", it is "satisfied with considering the effects of ignored causes, it follows experience and the evidence provided by nature"[9]. The ultimate constitutive principles of reality —essence, forces, causes, substances— are out of the reach of human understanding. We can only know the phenomenal properties of beings, that is their "nominal essence", not their real —metaphysical— essence (which would include the nature of their constitutive elements, the cause of their being connected, and the nature of the forces acting on them). This excludes themes such as the body-soul relation from the field of legitimate philosophical investigation, and puts them among the insoluble mysteries. This form of phenomenalism and moderate skepticism was far from damaging religious dogmas, of course. For instance, the fact that man cannot know the real nature of the soul-body relation did not clash with the proof of the immateriality of the soul, which was obtained on the basis of metaphysical principles[10]. The limitations of human understanding, the unknowable character of the metaphysical essences of natural phenomena simply draw attention to the need for an omniscient and omnipotent being. I believe that here a crucial connection with the contemporary evolution of theological thought towards Neo-Scholasticism emerges. Human reason can only ascertain metaphysical and religious truths, it cannot pretend to penetrate them, i.e. to investigate them gnoseologically. The capacities of human reason seem to be limited to that of the "recognition" of truths and of the "deduction" of other truths from them. As for Reactionary Catholic authors, so for reactionary philosophers human reason had no autonomous creative capacities.

The metaphysical part of the Wolffian systems of the Restoration age was immediately linked to the practical philosophical disciplines of ethics, law, economy, pedagogy, and politics. Every possible practical question had already a solution provided by the founding metaphysical system. So, for instance, from the basic ontological principle of non-contradiction it follows that in ethics, as in physics, contradiction is evil (it is for spirit "what a crippling is for the body"[11]). And "here is the cognitive principle, the first line of the natural code, which is necessarily true, certain, constant, immutable, evident and adequate; from which all duties and rights of man and citizen must be correctly deduced"[12]. The laws of moral and political order cannot but be part of the unitary system of laws ruling the universe, which is an organic and ordered whole. They enjoy the same metaphysical necessity. In the ethico-practical treatises of these philosophers, from the *Catechism* and the *Universal Code* of Capocasale (1792-93) onwards, a series of duties is deduced from the particular position of man in the system of the universe. The result is the eulogy of a prudent ethic, characterized by respect for the present moral and political order, by the proper exercise of human faculties, and by maintaining one's proper place in the great chain of beings. To behave otherwise would lead an individual to break the natural order, and be "in contradiction with himself"[13].

To sum up, the whole practical sphere of human life was deprived of any autonomy, and subtracted to the control of the individual. Ethics, law, pedagogy, politics, and economics were seen as mere articulations of a single fundamental body of metaphysically founded norms. Critical thinking and the discussion of the present state of society were ruled out *ab initio*. Man does not enter society as a citizen but burdened by a charge of duties. One sees how this matches with the absolutist conception of power which triumphed in the Neapolitan Restoration: authority was the legitimate criterion for "moral evidence"; furthermore, the practical disciplines were based on an omni-comprehensive system of norms which left no room for critique. The "real philosopher" we are told, is "the man who does not investigate inconsiderately with senses what must be investigated with reason; does not discuss with reason what must be discussed with testimonial; he is able to ignore what is not given to know; he knows how to limit his research, to doubt where doubt is reasonable, to accept the known truth, to be subject to infallible authority: he is the man who prefers to follow the truth with the common people, rather than falsity with the so-called philosopher"[14].

As in contemporary theological thought, in this academic philosophy the legitimate usage of individual reason was limited and pre-structured; while the innocent "common people" emerged as the repository of an original wisdom. Culture and science detached themselves from political debate, political events being "mysterious"; so that we had better "leave our destinies in the hands of the one who controls the fate of men"[15]. The grounding of society in religion is inevitable: "religion is like a strict chain which links everywhere one man to the others, one citizen to the others, the subject to his prince, and makes us observe the law"[16]. In the same spirit, Capocasale offered an argument to prove the reasonability of political intolerance, which was grounded on a paternalistic and authoritarian conception of power, apparently derived from Haller, whose *Restoration of Political Science* was published in Naples in 1826-28[17]. And with the recognition of the influence of Haller on the "official" philosophers of the restoration, and their organic relation with the basic tenets of Reactionary Catholicism, we can move to the more specifically scientific component of the movement.

5.2 Reactionary Catholicism and the Natural Sciences

Some of the philosophers and ecclesiastics cited in the previous paragraphs as exponents of the related positions of Reactionary Catholicism, Neo-Scholasticism and reactionary philosophy showed no deep interest in the natural and mathematical sciences *per se*. Mannheim claimed indeed that counter-revolutionary conservative thought was hostile to the spirit of the natural sciences, and to mathematics in particular, due to the general opposition to the encyclopedic knowledge of the "moderns", where natural and exact sciences play a crucial role. In fact, modern quantitative sciences are often criticised in the writings of Neapolitan Reactionary Catholics. Nevertheless, it is a main point of this study that such expressions of complete refusal to recognize the results of modern science were not representative of the whole reactionary movement. A very interesting form of empiricism was indeed elaborated by some scientifically trained ecclesiastics in collaboration with a lively school of mathematics which began to make its name in Naples around the mid-1780s, under the guidance of Nicola Fergola. Let us approach this position through the writings of a well-known Reactionary Catholic clergyman: the Oratorian Francesco Colangelo (1769-1836), Bishop of Castellamare and Minister of Public Education.

Colangelo entered the Oratory in 1783; at that time, as we have seen, the place was the see of an anti-encyclopedic academy, and the battle against the modern secularized and reformist culture was intense. He became the librarian of the famous Oratorian Library, which allowed him to deepen his knowledge of the classical and patristic literature (significantly, his favorite author was the anti-intellectual Tacitus). Since the revolutionary period he had contacts with a group of Neapolitan men of science and literati, and he was in correspondence with a number of other Reactionary Catholic thinkers active in France and Italy (among them Gerdil and Spedalieri). One of the first presentations of his political ideas were his reflections upon the Neapolitan Revolution, published in 1799 and dedicated to the Queen[18]. Directly responsible for the "disorders and crimes" of the revolution has been, according to Colangelo, the "pernicious system" of Rousseau, diffused in Naples by Genovesi, Filangieri, and Pagano. They were to be considered the fathers of a revolution which "assaulted the thrones, outraged the altars, and upset nature itself"[19]. In 1820 Ferdinando I pressed for Colangelo to be created bishop and, in 1824, he was appointed minister of public education. His conduct was so criticized by liberal opponents as well as fellow reactionaries, that he was forced to resign in 1831, the king placing him in control of the Royal Printing-Office. Allegedly, most of his attention was devoted to the investigation of the moral conduct and the private life of professors, while the educational system was left in a state of abandonment[20]. During his life he was indeed the symbol of the Neapolitan reactionary clergy —together with Archbishop Celestino Cocle, private confessor of the king— and he was, with Canosa one of the most hated symbols of reaction in liberal literature.

Colangelo was interested in science, philosophy and history, as his rich output testifies[21]. Unlike other reactionary ecclesiastics, Colangelo studied with interest the relations between religion and the mathematical and empirical sciences. In 1804 he published a most interesting book titled *The Irreligious Freedom of Thought, Enemy of*

Scientific Progress, where he accomplished a paradoxical reversion of the reformist conception, according to which the autonomy of the sciences from metaphysics was essential to their progress[22]. Terms like "philosophy" and "wisdom", Colangelo wrote, have always indicated that kind of knowledge which, using the contemplation of nature as a ladder, allows man to reach his Creator, and to "descend" from this vision to his duties towards God and towards society (as from the knowledge of God one can logically deduce the knowledge of man and of society). As the reader may suspect, here is another version of the *philosophia perennis* argument. This original "science of God" was the core of Greek philosophy —of Platonism particularly— and stated clearly that reason is a gift of the divinity, and it had to be employed not simply to reach material improvements (a goal we share with animals), but especially to recognize the existence of the Creator of the universe. This recognition took place through the contemplation of "speaking nature". Consequently, the science which dealt with God was the noblest, and the most fundamental one; whereas the other sciences constituted the "ladder" and were instrumental to its enhancements. So far so good, for Colangelo, but when it came to "the modern philosophers", things changed dramatically. In the modern age the very term "philosophy" has been abused to mean the "horrible enterprise of banishing the necessary Being from the World"; of abolishing any distinction between vice and virtue —the latter being reduced to pleasure and utility (obviously he refers to a sensationalistic foundation of morals); of striking at the values of honesty, decency, fidelity, loyalty. This is what has been called named "the progress of human knowledge". The whole "spiritual science" of the ancients, together with the Christian Revelation have been rejected as "old prejudices". But the social and political consequences of the modern, atheistic theory of knowledge are violence and destruction (and here he referred explicitly to Haller). Not surprisingly, Colangelo saw a basic element of moral corruption behind the whole modern philosophy. By attacking religion, these atheists aimed to free themselves from all those links and limitations which are "natural" to man —and which are naturally recognized by any virtuous person. In fact, according to Colangelo, the principles inspired by religion and those obtained by the use of reason must eventually coincide, given that nature and revelation are simply two different manifestations of God. It is personal interest that makes men deny the basic natural values; "if men had some interest in doing it, they would doubt even Euclid's *Elements*"[23]. In Greece and Rome, moral corruption had lead the way to atheism ("the plague of Epicureism"), which in turn caused the ruin of society. Similarly, in the eighteenth century, the much praised "freedom of philosophizing" was nothing else than a "license of scepticism". Modern philosophers merely repeat the ancient arguments of skeptics, cynics, Epicureans, and other philosophical sects which attacked the idea of God, upon which "the great systems of the past" were grounded (i.e. Plato and Aristotle)[24]. A series of quotes from Diderot, Voltaire, Helvetius, Robinet, Lamettrie, and Buffon are then presented by Colangelo to make clear that, no matter what they say, the moderns "want the world to be formed only by natural forces, without any immediate action of the Divinity"; and that their systems have the same value as the "childish tales of the ancient" (as Cicero defines Lucretius's atomistic system)[25]. In spite of their "freedom" moderns "had not been able to create a truly new philosophical system, or at least an argument to defend atheism": in fact both their arguments and doctrines are from the ancient pagan culture. For example, they maintained, following Epicurus and Lucretius, the existence of atoms and the idea that "motion is *essential* to matter"; and by doing this, "they threw God down from His own throne, and sat themselves on it"[26]. Interestingly, Colangelo observed that modern philosophers have transferred on to matter "all those attributes which should be referred to God"[27]. But their atomistic doctrine is simply fallacious, as experience shows that matter "is indifferent" to motion, that it is "brute" and "without free-will". But let us concede this point, he says, this will still not be enough to explain the system of the universe: "let us mix the letters of the alphabet and throw them on a table: will we obtain the Iliad, in this way?"[28]. On the basis of the principle that "an effect cannot contain more than was in its own cause", Colangelo concludes that "an *unintelligent* and *disordered* cause cannot generate such a wonderful order [of the universe]"[29]. Moreover, if matter is "the mother of everything", why we do not observe the creation of any new animal species? In a following argument, Colangelo presented the "system of the universe" as an enormous chain of "contingent beings"[30]. No one of these beings contains in itself its own "internal reason". Now, the error of many philosophers is to postulate an infinite number of links for this chain. Instead, it is more natural to think of one "hand" which sustains the chain. It is clear where the series of arguments presented by Colangelo was pointing: matter contains no self-organizing principle; the universe and "intelligent man" cannot be the product of chance; the *regressus ad infinitum* of causes is logically faulty. Everything converges towards a providential and teleological vision of the physical universe (to which the *pars construens* of Colangelo's book is devoted). Other typical Reactionary Catholic arguments of the book are the connection between deism and universal skepticism, and the pragmatic conception of religion as *instrumentum regni*. What distinguishes Christianity from the philosophical systems is that it is not "a system of metaphysics", as it can be grounded on matters-of-fact.

> It was convenient to religion, which aims to protect society, to be grounded on the same kind of evidence which supports society itself. What is this kind of evidence? The *factual* kind. On the basis of facts we recognize the authority of the Sovereign, of the magistrate, of the various Superiors who have authority over us, and we recognize the links of blood with our relatives. Similarly our rights, fortune, and hopes rest on facts.[31]

In a similar way, our duties towards God are founded on facts. This is what differentiates Christianity from the innumerable erroneous philosophies which followed one another as "different fashions". The evidence supporting Christianity is provided both by certain empirical facts and certain basic intuitive principles. The facts are the historical reports by the evangelists. Why should we trust Caesar's *De Bello Gallico* and not trust them? Colangelo inserted a long digression to make clear the historical basis for the history of Christ, quoting largely the pagan "enemies", whose evidence is considered more important than that of the Christian apologists. In discussing the problem of historical evidence, Colangelo faces the question of miracles, a widely debated issue, strictly connected with the question of the general laws of the universe[32]. Here is how Colangelo assessed the question:

> A miracle is a temporary suspension of the physical order [...]. The Author of nature doesn't contradict his own laws when he suspends them, nor does He change his own decrees, because the Supreme Intelligence not only disposed the ordinary laws of nature, but He also disposed the possibility of suspension.[33]

Miracles are possible because God rules the universe like "an absolute master", not like "a mechanical agent"[34]. The "deists" who deny the historical evidence of religion and the possibility of miracles are bringing a form of radical skepticism not only into history (why believe Caesar and not the Gospel?), but also into the sciences, as they undermine the principle of trusting those who accomplished experimental experiences in the past. On the contrary, Christian doctrine is a "friend of the sciences", because it shares those very principles which are at the basis of good sciences[35]. Among those principles is the awareness of the existence of God, and of his absolute dominion (*imperio*) over nature. Colangelo shows how this principle was present in the writings of Plato, Aristotle, Descartes, Leibniz, and Newton. Their philosophical writings, in spite of all the "superficial" differences, share a common process of "ascension" from the empirical ground to a necessary *causa prima*, and the rejection of the role of chance in the constitution of the universe. In particular, Colangelo stresses that "there is not any other hypothesis which submits the machine of the universe to the power of God in such a perfect way as the Newtonian one"[36]. He praises the *Principia Mathematica*, —and also the introduction provided by Roger Cotes to the 1723 edition— because there is proved the existence of a "non-mechanical force" (*forza immeccanica*) which pervades the whole universe; and he is pleased to quote the well-known sentence: "*et hi omnes motus regulares originem non habent ex causis mechanicis*"[37]. Quite traditionally, Colangelo divides phenomena into two different classes: those produced by secondary causes (like pendulum oscillations), and those independent from secondary causes (such as the motion of a body in a vacuum). Physicists have to research on the first kind of phenomena (as Newton did studying the motion of planet), whereas the second kind of phenomena can only be understood by making reference to the *Causa Prima*[38]. In an interesting note, Colangelo remarks that both Newton and MacLaurin were convinced believers, and he argues that mathematics is not intrinsically dangerous to religion. To this extent he quotes Father Antonio Valsecchi (1708-1791).

> I would like to entirely report a very Wise Dissertation, which has been given to me by *Signor* Giordano Riccati[39], a nobleman from Treviso who is well-known in the Republic of Letters. He composed it to combat a paradox put about by an Italian Gazette: *the study of Mathematics favors unbelief*. He shows that the fundamental points of our Religion, that is to say, the existence of God, the temporal creation of Matter, the origin and the system of the Universe, and other similar truths, can be proved with evidence by means of mathematical theories, which he properly manages. So that the same

> [mathematical] principles destroy the Materialist's irreligiosity. Given that, he concludes, the study of mathematics is far from favoring unbelief, as Libertines maintain, or as some not too wise men fear. On the contrary, they can be utilized as a light to know and to prepare arguments to defend Religion.[40]

Colangelo goes on describing how the Wolffian philosophical system yields necessarily the recognition of a wise Creator of the universe (not surprisingly he favored Wolff in metaphysics). But all this uniformity, he says, can hardly surprise us. In fact, all the great philosophical systems are founded on an eternal, immutable principle (P): "the effect presupposes the cause, and the quality of the effect determines the quality of the cause"[41]. Only the specific methods to prove the existence of God can change through history. In a similar way,

> geometrical truths have remained always the same, given that they are founded on eternally true axioms; they are equally evident following either the methods of the ancients or the modern methods.[42]

How could the Christian doctrine be an enemy of the sciences? In fact, "true sciences bend their honored brows in front of Religion", because the principle which is fundamental in their investigations, is also the principle by which we can prove the existence of God. In Colangelo's teleological perspective nature appears to its contemplators as a "sort of pyramid, whose breadth diminishes as its height increases"[43]. The philosopher-contemplator "ascends from one phenomenon to the next, as from one step to the next, until he finally reaches the last stone, that is to say the Will and the Power of the One who rules the whole construction".

Which method should be preferred in the scientific investigation of nature? "Not that by which one is immediately pushed up to the middle of the pyramid, because this would only confuse ideas"; if it is true that *natura non facit saltus*, even the observer has to proceed step by step. One has to proceed "from simple ideas to the composed ones", so that what is known could be employed as a step to reach the unknown. In doing this, the contemplator "follows the path of nature". This inductive procedure is, in fact, common to the investigation of the natural philosopher, of the metaphysician, and of the historian. If we show that it can even be used to defend the Christian doctrine, then the accordance between religion and science will be proved once more.

Actually —asks Colangelo— what did the Fathers of the Church teach us? First of all they ask us to "stop for a while, and to contemplate Nature, and the beauty of the heavens, which are decorated [*ornati*] by so many stars completing perpetually constant revolutions"[44]. Then, they invite us to ascend from the harmony and the evident teleological nature of phenomena towards the reason of this order; a reason which is not chance (a "*voce senza idea*", a word without any real referent), but a wise First Cause. Euler, says Colangelo, reached this conclusion starting from the simple contemplation of the human eye[45]. The First Cause can also be reached by observing the functioning of the "thinking principle" (human intellect) which is in every man and whose teleological function is plainly clear to Colangelo. Through this observation man realizes that he is the "monarch of the universe", that he is free, and that he has a will. Moreover, the man conscious of his thinking principle is immediately conscious of his heterogeneity with respect to matter. Matter is "extended, divisible, malleable, impenetrable, inert" whereas thought is "simple, unitary, active". Colangelo continues by showing how the Fathers of the Church proved the principal religious truths by applying the principle (P). Among other things, the principle (P) is used to prove the system of punishments and prizes in the after-life, and the immortality of soul. Finally, Colangelo applies (P) to the historical fact of the Revelation.

What is the point of this rather complex apologetic text? In his rhetorical and quotation-burdened way, Colangelo is showing the reader that the same basic principle can be used to acquire knowledge about empirical reality and super-natural reality. But he is also showing that, in spite of this fundamental unity of human knowledge, every branch of knowledge has its own specific methodology and its own specific way of arguing; and that, as for the Wolffian metaphysicians, in different branches of knowledge human reason can rely on different "kinds of certainty". The certainty of the exact sciences, which refers to intuitive or proved truths is one thing. The certainty one can have when dealing with empirical facts is another thing. The divide is sharp and insuperable: any attempt to know with mathematical certainty the facts and laws of the moral sphere is doomed to remain unfulfilled. Quoting his Latin copy of Aristotle's *Metaphysics*, Colangelo can authoritatively claim that "certitudo mathematica non in omnibus rebus querenda est"[46]. Much of the present philosophical confusion about mathematics and its legitimate applications, Colangelo argues, derives from overlooking the essential difference between mathematical "form" and the "content" of mathematics. The essence of a proof is indeed to be distinguished from its "geometrical *form*", which is a mere "bark covering the mathematical truths".

> Even in mathematics, those principles which are employed to prove that a given figure is a circle, cannot be employed to prove that a given figure is a square. In fact, they have to change according to the nature of the thing.[47]

Certainty in mathematics derives from the very nature of the mathematical truths (which are intuitive), not from the method employed to reach them. And, accordingly no methodology should be given absolute priority over the other, as different fields require different heuristic and demonstrative methods. The confusion between form and substance made many eighteenth century philosophers ("sophists disguised as geometers") introduce mathematics even "in those subjects which were not apt to receive it", by mean of a misleading and purely exterior apparatus of "propositions, axioms, corollaries". Then, in a crucial passage, Colangelo refers to some of these non-mathematizable fields:

> medicine, law, and history cannot be subdued to mathematics and to rigorous proofs. In these sciences we have to proceed by means of *probability*, *conjectures* and *approximation* to the truth.[48]

The geometer who mathematizes these sciences does not recognize their essentially different "nature", which depends on their different foundations, and ultimately on the "[ontological] relationships between beings". The point is that one cannot mathematically prove empirical truths, and conversely one cannot empirically prove mathematical truths. And the reason for that, is that the nature of the ideas we deal with in mathematics is a "clear and distinct" one. This is what allows the reasoning to proceed with great clarity and rigor. On the other hand, when dealing with empirical reality, all the philosopher can do is to try to "penetrate the darkness of the uncertain phenomena, to make conjectures, and to risk predictions".

The last chapter of Colangelo's book is devoted to showing that —contrary to the general impression— the progress of the sciences is advantageous for religion. Indeed, the more natural sciences discover the harmonious order of the world, the more religion is reinforced. Particularly after the invention of the calculus, one can really say, with the prophet, that " the Heavens tell the glory of God"[49]. Any branch of the natural sciences proves the existence of the Eternal Geometer, from astronomy to the discovery of the nutritional system of plants, or the constitution of the "animal machines". The discoveries of the modern sciences produce in fact ecstasy and wonder in the "observing philosopher" (*il filosofo osservatore*), and are powerful weapons to fight the atheist. The act of contemplation is described in mystical terms: the contemplator of nature experiences a "scientific *extasis*", he feels the "genial enthusiasm of his reason", which "measures the oceans and counts the stars, while he quietly promenades on the globe".

Significant use is made by Colangelo of the work of the well-known Neapolitan anatomist Domenico Cotugno, his personal friend. Among the important (read: anti-materialistic) consequences of recent anatomical discoveries, Colangelo cites: the confutation of the theory of a "common sensory" located in the brain, in which all nerves would converge; the reaffirmation of the "organicistic" conception of the body (against the materialistic idea of the body as the product of a casual encounter of atoms); the establishment of a non-material force producing voluntary acts (i.e. human will). Far from being dangerous to religion, "good" modern science is a rich source of arguments against atheism and materialism. Of course there are boundaries beyond which the methods of scientific investigation are useless. One should never forget, for instance, that religion "is part of a completely different order of truths and arguments"[50].

Colangelo's book is constructed to give the reader the impression that the modern, encyclopedic tradition is not only scientifically erroneous and religiously heretical (the two things coincide), but that, in fact, *it never existed*. What happened in the late eighteenth century was nothing but a pale reproduction of the original battle between the representatives of the *philosophia perennis*, the "religious philosophy" (Plato and Aristotle) and the atheistic "sects" of the atomists, the skeptics, and the cynics, who attacked reason and religion. In philosophy, *nihil novi sub solis*, but the eternal struggle of religious man against atheists. In the erudite-historical work of Colangelo we find the same striking features already seen in the contemporary political writings of Reactionary Catholic authors. Firstly, even when presenting Newtonian theories he quotes largely from the patristic literature; and when attacking the moderns he compares them to the Hellenistic schools, or to anti-Christian authors such as Celsus and Julian the Apostate. The immediate goal is to show that it is always the ancient debate which is going on, and that the haughty moderns, with all their feeling different from their predecessors (think of Cestari when he says that it is completely useless to look at Greek science, as it was essentially different from modern science, and his general attack against history), have said nothing really new. This is analogous, in philosophy and science, to the strategy of denying the possibility of any real social and political change by showing that "naturally" society tends to take a certain specific form, and that the French Revolution was nothing more than a temporarily, contingent disturbance in the eternal order of things. But there is another related goal which can be served by such strategy, and this is to bring the debate onto a plane where a response from the opponent cannot be seriously expected. This was precisely the strategy adopted in the patristic-based socio-political writings of the Reactionary Catholic authors grouped in the Neapolitan academy which met at the Oratory.

Colangelo had enough historical sensibility to allow, in the frame of this immutable picture, the temporary presence of periods of advancement and of decadence, both in art (produced by individual imagination), and in the sciences (where tradition is important, given that they are produced by "the purest and more spiritual part of intellect"[51]). Interestingly, among the causes for scientific decadence Colangelo pointed to the scant attention paid to experience, and the inclination to produce "abstract", "metaphysical" systems of the world (the exemplary case being Descartes'), "which are games of the human intellect", and which do not correspond to nature. This opposition between empirical, inductive procedures on the one hand, and abstract reasoning and the "spirit of system" on the other is, in the end, the basis for the announced "friendship" of Christian religion and modern empirical science. Indeed, not only does Christian faith prevent us from wasting our time in following the "old and childish speculations" (like the invention of materialistic cosmogonies), but it also teaches us to be virtuous, humble, and to keep our passions under control (as passions "are the enemies of our effort to climb the mount of knowledge, source of every earthly joy"[52]). Conversely, atheism would necessarily destroy the very basis of the sciences, as Colangelo reduced it to a form of self-destroying skepticism (remember the argument of Caesar and the Gospel), whereas Christian religion, to defend itself, uses precisely the most recent results of the sciences.

As an appendix to his voluminous book, Colangelo inserted a letter written to him by Nicola Fergola. We are informed that "this illustrious geometer, whom I am proud to have had as friend and *maestro*", kindly revised parts of Colangelo's book, and undertook to write this short apologetic piece, where "he shows how sublime sciences lead to religion", something which "he is also proving with his exemplary Christian behavior"[53]. It was 1804, and recent events had indeed made very clear who was for the king and for religion. The letter provides us with important evidence of the collaboration between this erudite ecclesiastic coming from the anti-encyclopedic tradition of the Neapolitan Oratory, and the leader of the most renowned school of mathematics in town.

In Colangelo's 1804 book one finds a position which I suggest we call "apologetic empiricism"[54]. In order to define better this position, it is necessary to look at least at another of Colangelo's many books: an apology for Galileo Galilei, titled: *Galileo as a Guide for the Young Student*. The date of publication is significant: 1815, i.e. at the moment of the second Bourbon restoration, when Canosa was given the Ministry of Police and cultural reaction ravaged the institutions of the kingdom. The book was dedicated to Nicola Fergola, "the second Galileo". Galileo is chosen as an example for the young because he was —at the same time— a true Christian and a sagacious investigator of nature. The aim of the book is to explain why, in spite of the great quantity of new instruments, machines and mathematical techniques, modern philosophers of nature have accomplished very few important discoveries, after the age of Galileo and Newton. "Euler, Riccati, d'Alembert, La Grange [Lagrange] and others have wisely written on Mechanics; but can they be named law-givers of motion like Galileo, Ugenio [Huygens] and Newton?"[55]. Of course they can't, according to Colangelo. In fact, not only is it the case that "the progress of mixed mathematics has not been proportional to the quantity of new instruments", but also, as a consequence of the new mass of conceptual tools, "the contemplation of nature has been oppressed by a quantity of analytic formulas, *the great part of which, are not part of it*"[56]. Colangelo is here literally quoting from a textbook of Newtonian physics published by Fergola in 1792-93, where it was argued that the impressive development of eighteenth century calculus has "covered" nature with artificial formulas making more difficult the empirical observation of phenomena[57]. It is thus necessary, according to Colangelo, to go back to the original source of modern science, to Galileo, in order to individuate those methodological principles which guided his scientific work, so as to understand how, "without any knowledge of the mysterious arcana of analysis, he could surprise the penetralia of nature"[58]. The principles Colangelo is looking for are those which "regulated the spirit" of Galileo during his investigations, so that young students understand what it means to have "the rare and sublime prerogative of the contemplator". The introduction also contains an interesting comparison between the political and the scientific dimension:

> Political states need, every now and then, to be brought back to their original principles. The same holds for the sciences in the different nations, given that every product of man contains in itself the sign of fragility and decadence, which is proper to its author.[59]

But if, in politics, the return to the original tradition can be accomplished by some accord between the nations, in the case of science "to recall men to the ancient order" needs the appeal to the example of some great man, to "awake the sleeping spirits, and to bring them back on the right way". As the Congress in Vienna planned the return to order in politics, so Colangelo planned the return to order in science, which must consist in the restoration of the "right way" of studying nature, i.e. "not by making violence on nature, but by following its inclinations"[60].

Galileo's life is apologetically reconstructed. "Nauseated by the Peripatetic Philosophy", he maintained "that wise and careful freedom of philosophizing which was the principle of all his discoveries"[61]. Having read Colangelo's 1804 book, we already know that the true "freedom of philosophizing" is not the skeptical and sterile attitude of modern thinkers, but the refusal to take for granted one or the other of the abstract "systems of the world" invented by philosophers. In this sense, the best example of freedom of philosophizing is the Newtonian "*hypotheses non fingo*", as a prelude to a strictly empirical study of nature. Colangelo emphasizes the importance of Euclidean geometry in the education of the young Galileo, quoting largely from Viviani's biography[62]. Geometry provided him with the right way of arguing and drawing conclusions, much more than all the other "logics and philosophies". About education in general, Colangelo opposes the idea of the equality of the intellects. Any mind has its own abilities, and "the equality of intellectual forces" is just "a dream". Trying to teach the "art of geometry" to a mind not naturally predisposed to receive it, is a case of violence against nature: it can produce only weak or negative effects[63]. An entire chapter (the second) is devoted to "the respect due to Euclid's *Elements*", which presents to the pupil "the naked, beautiful, simple and ordered truth"[64]. In fact, all the great geometers praised this work, whereas, presently, many people who "call themselves geometers", look down on the Greek geometer, who is accused of being "prolix and tedious". Galileo is the best weapon to reply to those pseudo-geometers. In the chapter on Galileo's religious feelings (the third), which concludes the biographical reconstruction, Colangelo quotes from the *Dialogo*, to show Galileo's "profound respect for the infinite Majesty and for the universal Providence of God"[65]. "You can then concretely see" concludes Colangelo, "that it is possible to be a sublime philosopher without getting misled by the insanity of the so called free thinkers"[66].

The remaining part of the book is then devoted to the exposition of "the canons to philosophize on nature, which are derived from Galileo's work". Among them, Colangelo put the following:

- One shouldn't create in his own mind the "system of the natural laws", and then pretend to find them in nature. In fact, God created nature in the first place, "and then human discourse, which makes it possible to understand (not without a great effort) some of its secrets"[67]. The one who forgets this (the "philosopher *in libris*") cannot reach the true knowledge of phenomena and of their laws.
- In spite of the advancements in the study of nature, "men will never know the intimate essence of things"; they will never entirely comprehend the order and the many laws of the universe. Galileo never tried to build a cosmogony.
- "What escapes our understanding must not be condemned as useless or badly disposed by nature". For example, why are there incommensurable proportions in nature? Why are stars in the sky not symmetrically disposed? The error here consists in applying the limited capacities of human reason to the inscrutable action of God.

- The opinions of the ancient philosophers have not to be immediately refuted, but "must be rigorously tested", i.e. we have to check if they correspond to natural phenomena.
- We must give up our beliefs if actual experience, or certain clear arguments, can prove their falsity.

Given these very general principles, Colangelo moves to a series of specific canons for the empirical investigation of nature, like the method of the "supposition of the fact": one takes for granted certain assumptions, and then one checks if they are consistent with the observations (this method is clearly the empirical version of the geometrical method adopted in Fergola's school). But we have the right to suppose that something is the case only if there exists some supporting evidence; otherwise the supposition is simply "poetry", and in the investigation of nature there is no place for poetry. Another canon states the difference between geometrical and empirical investigations: "the true Method to progress in the science of Nature, is the *inductive* one"; according to it, one moves from phenomena to the discovery of their causes. Another states that "final causes must not be excluded in the investigation of nature", and to this extent, Fergola is quoted:

> the laws of natural phenomena can be investigated by the analyst in two ways: the way of the efficient causes and the way of the final causes. In the first case, it will be sufficient to consider the values of the forces, their effects, and extract the laws of motion. In the case of final cause, we will calculate the quantity of action of the mobile, and we will employ the *maxima et minima* method.[68]

A last canon states that "observation and experience have to precede calculations; great caution is indeed required to subdue the laws of Nature derived from phenomena to geometrical rigor"[69]. Of course, as Galileo said, "the great book of nature is written in mathematical language", but the same Galileo "traced the border between physics and mathematics, and recognized the preeminence of the first over the second one". The point is that the "imperfections of nature are powerful in contaminating the very pure mathematical proofs"[70]. In this case, Galileo's procedure, according to Colangelo, was the following:

> he kept his eye fixed upon nature, following its lines, its triangles, its circles by means of complete and exhaustive observations and experiments. He

> considered exactly all their features, and with great naturalness he grafted geometry on them. He did this in a way which made it almost impossible to distinguish whether it is the Geometer or the Observer who speaks: so linked Nature and Geometry proceed.[71]

Colangelo goes on (chapter six) presenting and commenting on some aphorisms on nature from Galileo (for instance: "nature does much with little"). Then he praises Galileo's writing style: it was precise, clean, rigorous, but also ornate and elegant, in the tradition of the Latin and Italian classic literature. On the contrary, Colangelo complains, many modern texts of mathematics are deeply obscure: "some of those who study mathematics believe, erroneously, that they have only to contemplate abstract truths, and then to apply them to the science of nature; so they think they are not obliged to express their thought with a decent propriety of language"[72]. Colangelo then emphasizes the attachment of Galileo's pupils to their *maestro* (chapter eight), and the solid structure of his school. Interestingly enough, in Colangelo's historical reconstruction —where the Church is the natural ally of modern science— Galileo was obstructed by "contemporary philosophers", who supported an abstract philosophy and had no consideration for experience. Students are recommended to read the original works of Galileo, and to continue his work, but always paying attention "to maintain pure the Catholic belief"[73]. A good example of working in the path of Galileo is provided by the Neapolitan Alfonso Borelli[74], a true "Catholic scientist", who provided further evidence for the argument that "the contemplation of Nature is the stairway to the Creator for anyone who is not a useless burden to society, virtue and science", and that "the mysteries by which Nature covers itself concur to bring our intellect to faith"[75]. The book closes with a quotation from Galileo: "geometry teaches modesty to philosophers, and diminishes their arrogance by showing how few the proved truths are, and how one should always proceed very carefully in drawing those conclusions, which cannot be certain but only probable [*verosimili*]"[76].

5.3 Ventura on Fergola as "Spiritual Mathematician"

In 1824 Fergola died "turning his eyes to the beloved image of the Virgin". His body was transported from the house facing the Church of the Oratorians to the baroque church of the Theatin Fathers, Saint Paul's, where he was buried. The funeral has been described as a sumptuous ceremony, attended by a number of ecclesiastic and secular personalities, and by the whole faculty of the RUN. The funeral oration was given by a famous speaker, and the leader of the Reactionary Catholic movement in Italy: Gioacchino Ventura. In his speech Ventura aimed "to promote those principles of order which, in the strange circumstances we live in, are the real needs of the soul, and the only hope for society, which is threatened by total dissolution"[77]. In particular, Ventura aimed to show "the secret affinities between religion and mathematics, their relations, and the reciprocal advantages of their cooperation"[78]. He aims to reply to both those who believe that religion is the enemy of the sciences, and those who consider sciences dangerous for the true faith. Secular and religious knowledge can indeed be unified with reciprocal advantage, as it clearly emerges from the work of Fergola, "great mathematician, philosopher, jurist, but overall great Christian"[79]. In fact, the attempts "to secularize science", i.e. to separate science from religion, have only "degraded, humiliated, and deprived science of every solidity, nobility and utility", as "only *what is true* can produce what is noble and useful"[80]. Fergola was the living proof that scientific knowledge can be acquired only via the practice of religious virtues such as purity, humility, and moderation. On the contrary, moral vices weaken human reason, and "materialize" it; as "what corrupts affections, also obscures reason, and what deprives the heart of its virtues, also distracts the spirit from science"[81]. Fergola, like Thomas Aquinas, realized that prayer and self-purification are the way to erudition; and his reason, "once freed from the weight of senses, developed and became nobler". Thanks to this "purification", Ventura remarks, "mathematics began to shine with a new light among us". The other cardinal virtue for science is humility. Pride is "the plague of the modern young": they believe they know everything as soon as they get out from the college just because they have done a little algebra. Mathematicians are particularly inclined to the sin of pride, because their discipline "is the only one that can be said to be a *human creation*, and no one is more suitable to inspire the cult of reason", according to which cult, the mathematician "doesn't respect the limit of human reason, the mysteries of nature, those of religion, and he pretends to subdue everything to the rigor of his calculations, including feelings"[82]. Not Fergola, though, as "in vain [the French] tried to make him accept honors, decorations, titles, [...]: nothing flattered him", and if others accepted those "profaned crosses" and "prostituted insignia", Fergola "remained what he was"[83]. The praise of Fergola's religious virtues and their constitutive role in shaping his scientific production is placed in the usual context of the "philosophical plot"; what is interesting is that Ventura refers to the specific role played by the mathematical sciences in the plot. The tone is apocalyptic: "in these last days of the world", the evil use of science "has been fatal". "The sciences have ruined man and then they have ruined society"; in particular, "among the sciences it is mathematics which took the most erroneous and deplorable path". Mathematical sciences "have in fact played a central role in the plan elaborated by philosophers to attack Christianity", as "being less known to common people they could better surprise and deceive them". So that

> square and compass became deadly weapons in the hands of irreligion and pride; they have broken any restraint, they have unchained all the passions, and in so doing they have eroded the foundations of religion and order.[84]

What Fergola has understood, unlike men such as d'Alembert, Condorcet, Lalande, and Laplace[85], is that "there are different kinds [*ordini*] of truth, and then different means to acquire knowledge"[86]. What they tried to accomplish was to illegitimately turn mathematics into a "*universal science,* the key and the fundament of every other form of knowledge"; they thought that "there wasn't anything certain but what could be reduced to geometrical theorems". Every dogma, Ventura continued, from the immortality of the soul, to its spirituality, to the distinction between good and evil, has been rejected as a prejudice "just because they cannot be proved by means of lines, angles, circles and squares"[87]. Every branch of knowledge "has been *algebraized,* including human feelings". Fergola, on the contrary, following the path of men like Newton, Leibniz, Pascal, Cassini, and Torricelli, "considered human reason simply as an instrument to investigate earthly matters, and he chose a very different guide when it came to the heavenly truths, where he recognized indeed the presence of a superior reason". Fergola who, "the more he rose in his scientific career, the humbler he became in religious matters".

The point, says Ventura, is that in the seventeenth century mathematics was an "intellectual science", which was able to lift man up towards his Lord. But the following was a century of "irreligion and disbelief", and the "furiously cultivated" mathematics was reduced to a "material science", practised by the "miserable, cold, haughty, resolute, *algebraists*", whose reason had been "degraded and sterilized by atheism", and who "only looked towards the Earth, being themselves —as a great thinker of our age said[88]— mere *geometrical machines*, which execute complicated operations, not unlike Pascal's machine"[89]. So, if Newton, Leibniz, Pascal, and the others of the seventeenth century were "great mathematicians", the *philosophes* were merely "skilled calculators". The first recognized in the heavens the traces of the "powerful hand" of the creator, and they "never operated on numbers and figures without going back to the *Eternal Geometer* of Plato, the *Prime Motor* of Aristotle", so that "through the circle and the triangle they recognized the Lord". The second, "only saw lines and curves in the universe", "cold formulas" being their only interest. "A+B=C captured all their attention, and in their minds no interest for truth was left, nor virtues in their hearts". Unlike their predecessors, "through the circle and the square they couldn't see anything other than matter, and behind the matter, they found only nothingness".

Thus, if in the past (the mythic past of the *philosophia perennis*, of course) the two terms "mathematician" and "atheist" were plainly contradictory, today they are generally considered synonymous. Not for Fergola though, who intensified his Catholic devotion "in those very days when religion was considered a mere prejudice", with the explicit goal of "divinizing science", against the dominant secularizing trend. In fact, "in his mathematical writings one always finds, wherever it is least expected, some defense of the [Christian] truth so that, without realizing it, one is elevated from the earthly science to the heavenly one, from man to God"[90]. Continuing with his elaboration of Chateaubriand's notion of "material" and "spiritual" science, Ventura remarked how the "materialistic century", with its reductionistic trend, on the one side condemned all the "speculative and intellectual" sciences, and exalted the empirical ones; on the other side it used mathematics "to diffuse error and insurrection", transforming it into a sort of new religion. "In fact" remarked Ventura, "these mathematicians were successful in founding their own new religion, whose choirs were oaths, whose sacrifices were massacres, whose divinity was a prostitute, the *goddess reason*, whose priests were Condorcet, Robespierre, Marat and Danton"[91].

Fergola proved that religion does not oppose the development of mathematics: "it is simply a question of passing from the contemplation of the magnitudes of God to procure His glory". Fergola was both a Christian and a wise man, and he was wise because he was Christian. Ventura concluded his speech exhorting the professors assembled in the church to punish those proud spirits who want to surpass the natural limits of human reason: "don't let those who introduce anarchy and disorder into literature, attack religion, and in this way introduce disorder even in the state"; with the "Christian man" would indeed disappear even the "good, wise, pacific citizen" [92].

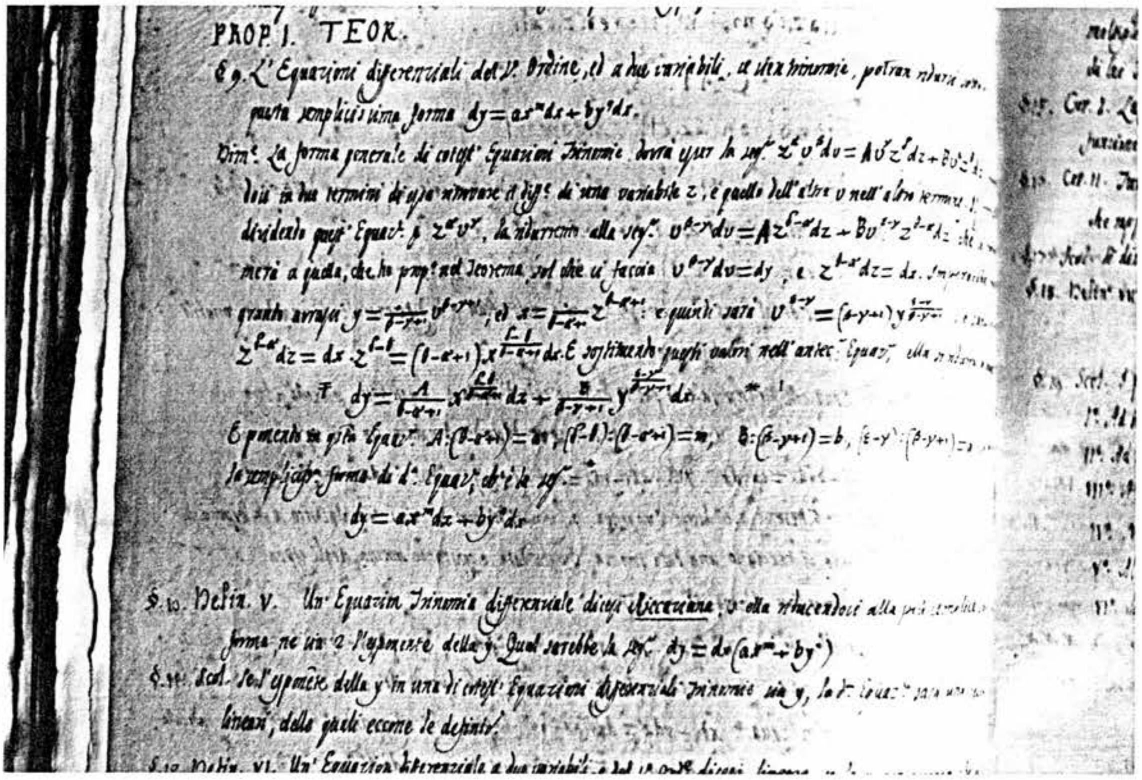
We have been approaching the figure of Fergola through the use made by Colangelo and Ventura of his work. Was this use "betraying" Fergola's original intentions? Apart from the lack of mathematical competence and the overly polemical tone (both of which are particularly evident in Ventura), I believe that the reactionary ecclesiastics got the fundamental goals of Fergola's work right. Unlike Franco Palladino, I do not believe that Fergola simply found himself in the middle of an ideological battle of which he became unwillingly a part[93]. What we have found in bits and pieces in the writings of these ecclesiastics are indeed parts of a unitary system of thought where empirical sciences and mathematics are shaped by a fundamental apologetic aim. As it was for Lauberg, Fergola's biography has been artificially split by historians: on the one side one has Fergola the mathematician, on the other Fergola the devout Catholic and legitimist professor who sat in a number of counter-revolutionary special commissions charged with restoring order in the sector of education. Once again, our aim is to make sense of his mathematical work by looking *also* at his religious and political beliefs.

5.4 Fergola: Reason, Nature and Mathematics

The lectures and writings of Nicola Fergola were the main resource for those Reactionary Catholic authors who were interested in epistemological problems and in the relations between human reason, science and mathematics. Whether it was an erudite scholar like Colangelo, a secular politician like Canosa, or a religious activist like Ventura, they all seem to refer to the conceptual framework elaborated by Fergola when it came to science and mathematics. Of course Fergola himself was not working in the void, as he relied on much of the material we have been presenting so far, which included the intransigent and anti-modern tradition of the

Neapolitan Oratory, the post-Wolffian metaphysical philosophy, and more recent forms of counter-revolutionary though. His original and important contribution was to revive the study of mathematics in Naples, being careful in shaping this revival accordingly to an anti-encyclopedic system of knowledge. To make this point clear, let us begin by considering his textbook of natural philosophy.

Between 1792 and 1793, Fergola was officially asked by the authorities to publish his lectures on natural philosophy[94]. The two-volume textbook, written for the pupils of the College of the Saviour, was extremely successful, and enjoyed a particular fortune among Reactionary Catholic authors. The title was *Lectures on the Mathematical Principles of the Natural Philosophy of Sir Isaac Newton*, but in fact the text included much more than that, and it was extended to the latest developments of eighteenth century mechanics. The first volume was devoted to mechanics, the second to statics and to the science of fluids. Amodeo praised this work ("a jewel") for its clarity and for its substantial historical notes: every issue is indeed introduced through its historical genesis (which was very unusual at that time), and the various contributions are accurately presented and weighted. The starting point is usually a passage from Newton's text, but then Fergola gave evidence of his wide erudition by quoting the relevant work done in the last century up to Lagrange's *Mechanics* (1788), which is often praised[95]. Lauberg and Giordano are also praised at same point, which made Amodeo believe that the anti-Lagrangian spirit of Fergola's school was just an historical misinterpretation[96]. In fact, the question is somewhat subtler than that. What these references prove is that Fergola was very competent in contemporary analytical mechanics, so that he could not overlook the relevance of Lagrange's work. That Fergola was deeply interested in studying eighteenth century analysis has been recently confirmed by the study of his unpublished lectures and treatises now at the National Library of Naples[97]. These eight volumes of manuscript material include —among other things— the following items: introductory remarks to infinitesimal calculus (1805-1810ca); treatises of differential and integral calculus (1788-1807ca); a treatise on series; a treatise on variation calculus (1795-98ca); elements of algebra (1800-1807ca). Such an interest in "analysis" in the founder and leader of the most combative synthetic school of geometry of his time is certainly striking. The historians who first catalogued the material in the 1990s have been inclined, like Amodeo, to believe



A treatise of calculus from Fergola's manuscripts (ms.III.C.31) that Fergola's teaching was somehow misunderstood and betrayed by his own pupils: after all Fergola was not that bigot and backward geometer they thought he was. In my opinion the choice between a Fergola ignorant and backward, and a Fergola "modern" but misunderstood, is false and misleading. The fact is that Fergola was competent in the various branches of modern analysis. This is not too surprising because, as we'll see, his mathematical education had been similar to that of Neapolitan supporters of analysis. But, is this interest in analysis in conflict with the emphasis upon geometrical problem-solving methods? I believe the right answer is "no".

Fergola's treatises of analysis were written and re-elaborated between the 1780s and the 1810s. The treatises were written for didactic purposes, but through them Fergola was also pursuing a clear foundationalist, "Euclidean" program. "The first geometers" he wrote "who discovered Infinitesimal Analysis and those who extended their research, did not care to clarify its principles as they should have in order to make of it a truly fruitful Science"[98]. Practical success was not enough for Fergola to ground the calculus, or to make it "a science". He aimed to provide the calculus with the same kind of rigor enjoyed by classical geometry, avoiding any reference to induction, empirical truths and to practical applications. "Rigorization" then meant to "purify" this branch of mathematics and rid it of the presence of empirical considerations. This purification seems to be pursued in different ways; as if Fergola were essaying different solutions for this crucial problem. On the one hand he tried to ground as much of calculus as he could on geometrical intuition (so he revived Newton's theory of fluxions; he provided a geometrical definition of infinitesimal; and so on). On the other hand, he tried to give a "Euclidean form" to the algebraic-symbolic calculus of Euler and Lagrange, which he sees as eventually irreducible to geometry, as it is not grounded on geometrical intuition, but rather on algebraic reasoning. Fergola seems to think of it as of a "method" which allows the manipulation of symbolic expressions for discrete magnitudes (whereas geometry deals with continuous magnitudes). An epistemological divide separates this symbolic method from the evident knowledge provided by geometrical intuition. In order to give a Euclidean form to "symbolic calculus", Fergola presented axioms and definitions, plus certain laws to be employed to prove rigorously its theorems, in order to transform "their concatenation into an ordered system". From a series of useful techniques the calculus should then become a unitary and self-contained branch of pure mathematics (dealing with a certain kind of magnitudes —the discrete ones). Fergola was deeply interested in these topics during the 1780s. The fact that he never published these works is probably due to his judging his results unsatisfactory. In the end he had not been able to provide a coherent and all-inclusive alternative foundation of analysis to oppose to the algebraicized conception of analysis defended by the Lagrangians. Since the 1810s, the harsh controversy with the analytic school contributed to shift further the interest of Fergola and his pupils towards pure geometry.

Let us now go back to the textbook of mechanics. It is crucial to grasp what — according to Fergola— are the relations between mathematical knowledge and reality. We have already pointed out a first feature of the book: its unusually detailed historical apparatus. A second feature is the geometrical form of the text, as Fergola tried, whenever possible to offer geometrical proofs of mechanical truths. About the contents, the crucial notion in Fergola's mechanics is that of "force". It is interesting to compare his treatment with that of Lauberg in his 1789 essay on mechanics. Where Lauberg rejected the study of the "nature" of forces as unessential and metaphysical, limiting his interest to the their measurable effects, Fergola wrote that "the aggregation of the forces has been placed in the elements of matter by Nature", so that "it is the soul which informs the immense mass of the universe, and gives life to it". Consequently, the study of forces "is not a vain or despicable effort, but truly a way to essay the laws of the Universe, and the deep wisdom of He who rules and sustains it". The fact that we —"mortals"— cannot penetrate the intimate nature of the forces acting on matter, is due to our limitations, but this nature itself is far from being "irrelevant". All we can do is "to spy some of the relations" among forces, and thanks to this observation "to find the principles of mechanics and static"[99]. The knowledge of the real essence of phenomena such as the transmission of motion or the composition of forces, will always remain "mysteries" for philosophers as for the ignorant people. At the end of the inexplicable chain of "moving powers" (such as muscles, elasticity, gravitation,...), which we can only try to describe, there is "the Hand of the Living God", the ultimate "moving power" of the universe "which one day threw out the planets and the comets, and nowadays nourishes their declining motions"[100]. Galileo, considered as the "Father of the Contemplators of Nature" discovered the basic laws of motion, which are "mechanical truths" and then contingent, as they could have been different. They didn't emerge from matter itself, but rather "an extraneous Being prescribed them, choosing those which would maintain natural motions with a minimal action". In fact, "the stupid and inert chance cannot be the Great Geometer of Nature", as there is an indefinite number of contemporaneous motions in the universe, which means an indefinite number of problems of *maxima* and *minima* to be solved contemporaneously. So, following Maupertuis, Fergola, made an explicitly apologetic use of the principle of minimum action, which is presented as "the more powerful argument against atheism"[101]. Towards the end of the textbook, Fergola presented four interesting "canons to guide the geometer in the Contemplation of Nature":

1) "Geometry and Analysis have to be the Handmaids of Nature, not their Masters". Fergola explains that mathematical formalism, when improperly used by philosophers, covers the real "data" offered by nature. That is to say, the mathematization of reality has to be carefully accomplished, without forcing the world of experience into extraneous mathematical forms. "This abuse" makes theories of nature closer to the "world of abstractions" than to the real world.

2) "Contemplation of Nature must not be oppressed by that set of analytic formulas which are mostly extraneous to Nature itself". The previous canon told us that mathematics, when abused, covers nature with its own artificial apparatus. Now we realize that the responsible for this progressive occultation of nature are in fact the "analytic formulas". This "canon" was quoted literally by Colangelo, who attributed it to the Galileian tradition. Fergola continued:

> The excessively metaphysical minds are used to looking at Nature through the systems they themselves invented; and the great calculators often get lost in their considerations about formulas which are hardly part of Nature: so that many physico-mathematical treatises are purely analytical exercises. But the ancient Italian Geometers and foreigners such as the great Newton, Varignonio, D. Bernoulli, Lambert and others, avoided such an error.

3) The third canon defends the notion of "final cause" in physics, which of course is central to Fergola's providential view of the universe. "The Analyst desiring to

be a faithful interpreter of Nature, must make practice in deriving the laws of the natural phenomena from both their efficient and their final causes".

4) "The Analyst must make practice in the method of finding the laws of natural phenomena on the basis of observation". This was indeed the path taken by Newton himself, when "with the [help of] Geometrical Science he spied the motions inside resistant media, and he was able to elaborate those theories presented in the second book of the *Principia*"[102].

In the end, Fergola's textbook was an up-to-date and clearly written treatise of rational mechanics and theory of machines; and, crucial to its success, it presented this material in a theoretical framework which was greatly appreciated in the rapidly growing area of Reactionary Catholic thought. Describing Colangelo's work, I have referred to "apologetic empiricism", as characterized by its opposition to the eighteenth century "systems of the world", where the whole universe was explained on the basis of certain metaphysical principles (atoms and the void, for instance), using as its main explanatory instrument mathematical formalism —as if it was a legitimate instrument *per se*. Apologetic empiricism defines itself in opposition to the "spirit of system" and to the artificial worlds of metaphysical mathematicians. It defines itself in opposition to "the spirit of analysis". The wise contemplator must let nature speak for itself, without imposing his artificial symbolic language on it. He knows humans cannot fully understand the universe, and they can only glimpse a few principles and discover some of its laws. But this empirical knowledge is essentially fallible, based on induction and conjectures. It is far from enjoying the certainty of mathematical truths. The trick of system-makers is precisely that of giving mathematical form to their statements, so that they can pretend their empirical statements are absolutely certain. I call this form of sceptical empiricism "apologetic", because its moderately skeptical content served an apologetic goal.

We have already seen how it works in Colangelo; let us see now how Fergola himself linked philosophy of nature, mathematics and religion. This is indeed the subject of a rather peculiar (and not too organic) text written by Fergola around 1804, and published by Flauti under the title *Theory of Miracles* (1839)[103]. The book has not been considered relevant by those who have studied Fergola's scientific productions so far. In fact, it deserves attention because it contains important material about Fergola's epistemological views. The work originated with Colangelo, who asked Fergola to accomplish "one of the many proofs which decisively prove the existence of God, obtained from the sublime contemplation of nature, and supported by the light offered by Sublime Analysis [calculus] and Geometry"[104]. Fergola's letter of reply contained significant passages:

> When I see the eternal splendor of stars, the harmony of their motions, and the beneficent positions they have relatively to us, I see the right [hand] of the Lord, who maintains this Universe, which He created out of nothing. But even remaining on our planet, and looking at the three Kingdoms of Nature, how many things I admire! The seeds of plants and animals accomplishing their admirable function, fecunded by Nature. And in every seed is hidden an infinite series of decreasing seeds, all of them endowed with the same virtue and the same mechanism. And this makes me say to the hardest and most impudent atheist: Look, you who extinguished your intellectual light not to see the Lord, you have to recognize Him in the Universe.[105]

Anti-atomism and the conception of a providential, active divinity, are the two pillars of Fergola's natural philosophy. Flauti engaged his son, Giovanni, to edit the first edition of the book. Starting from some Leibnizian reflexions[106], Giovanni in his preface argued for the possibility of miracles, and for their central role in Christianity. The point is that the Lord, who created the universe from nothingness, and established the laws of nature, can certainly intervene again to make extraordinary phenomena possible. One knows that this is possible, but the modality of his action —like the "real" functioning of nature in general— is inscrutable by humans. One cannot know how miracles are performed (by suspending the laws of nature? by changing them? by modifying the substances?). Consequently, human reason must simply accept their reality, without questioning their nature[107]. A good example of the apologetic style of Reactionary Catholicism, where the truths of religion are not proved through rational arguments, but instead authoritatively communicated to the believers *against* their rational inclination, as human reason is too weak an instrument to investigate such matters and, more importantly, because it is not legitimate to do so. The argumentation is reminiscent of much patristic literature (beginning with Tertullianus's "credo quia absurdum"); it is no accident that patristic literature was a favorite source for Reactionary Catholics. As we have seen, human reason is conceived by them as essentially passive, non creative; it can mirror and recognize metaphysical truths once they are revealed, but it cannot reach them autonomously, nor prove or disprove them.

Fergola's text on miracles follows the same lines. Originally, we are told, the Lord imposed his laws on everything, including human actions. Men could recognize the divine laws only through Revelation, and miracles were the essential instruments to support the message of the Revelation. They are in fact the foundations of our religious belief. Some philosophers tried to deny the very possibility of miracles, but "they can hardly be said to be philosophers", as the wise man contemplating "the book of nature, where are clearly signed the eternal laws and the admirable order" of the universe, understands that all this is in itself "a continuous miracle". Also a miracle is his own "semi-divine mind", which has to be employed not against its creator, but to recognize His greatness. A miracle, Fergola said, is "a phenomenon which cannot be naturally explained". Any other definition is logically contradictory and many, such as Spinoza's, are clearly blasphemous[108]. The argument on miracles is based on the important assumption that there is no "absolute necessity" in nature (remember that laws of motion were presented as contingent in the textbook of mechanics). More precisely: there is no absolute necessity in our knowledge of nature. This is a central point, in Fergola's natural philosophy:

> if all the phenomena were absolutely necessary and immutable, the physical truths would have the same mathematical certainty as the geometrical ones; thus cosmology, physics and all the natural sciences should be similar to geometry and arithmetic, and their proposition should descend directly from the non-contradiction principle. But the three laws of nature proposed by Newton and by other deep physicists as axioms of dynamics, descend from the principle of sufficient reason, and no philosopher could derive them from the principle of non-contradiction. Then, all natural truths are contingent.[109]

The imprint of the Wolffian metaphysical perspective is unmistakable: the whole of mathematics is (ideally) derivable from the logical principle of non-contradiction, while empirical, contingent truths derive from the principle of sufficient reason[110]. The connection between metaphysical and empirical knowledge is essential and all-pervasive, and it makes knowledge an essentially unitary phenomenon: unified by the teleological perspective. Yet unified does not mean non-hierarchically structured: the division in metaphysical knowledge, mathematical knowledge, and empirical knowledge is clear, in Fergola as in the Wolffian philosophers such as

Capocasale (who, by the way, got his chair at the RUN thanks to the increasingly powerful Fergola). And what was this if not a recovery of the original threefold partition of human knowledge operated by Thomas Aquinas? Thirty years before the official rediscovery of Thomism and scholastic philosophy by Ventura and the Roman theologians, Fergola used Aquinas to provide a solid —hierarchical— structure for his own conception of human knowledge. The fact that Fergola's fideistic perspective is very far from Aquinas's rationalistic enterprise is not directly relevant here. Fergola's fideism emerges when he moves to the famous question of the *vis viva*[111]. Fergola argued that the total quantity of *vis viva* in the universe is not constant. He recognized that he was contradicting some of his favorite authors, such as Johann Bernoulli and Christian Wolff, who argued for the stability of the universe on the basis of the principle that *in corpore nulla vis oritur, perit, variationemque subit nisi per conflictum*. But that any variation in the forces is reducible to some "conflict" is clearly false to the fiercely anti-mechanist Fergola. Counter-examples are the variation of forces acting on a comet gravitating around the sun; the "muscular forces" acting in animals (caused by a material "fluid" whose action is originated by an immaterial principle); the electrical and magnetic forces of attraction; and, likewise, many other innumerable forces "hidden in the universe". These are clearly not "forces of contact [*forze d'urto*]". Then Fergola argued that the overall quantity of force is actually decreasing in the universe, which means that "nature cannot sustain itself", and the stability of the universe implies a continuous infusion of new forces *ex nihilo*, operated by God. Obviously the main reference for this point is Newton, "who discovered the true laws of nature", and argued for the necessary action of "the hand of God". Fergola adopted in full Newton's fideistic definition of God as the one who *omnia regit, non ut anima mundi, sed ut universorum Dominus, et propter dominium suum Dominus Deus* παντοχρατορ *id est Imperator universalis, dici solet* [...]. *Deus sine dominio, providentia et rationibus finalibus non esset nisi natura, aut fatum*. Fergola commented: "the Lord rules the heavens and nature like a sovereign. He didn't write the destinies of things like constitutional laws of the universe, to which being Himself subject. He is not the god of the Stoics, *quid scripsit fata, sed sequitur qui semel jussit et semper paret*"[112].

In a similar way Father Ventura, in his speech occasioned by the death of the intransigent Pope Pius VII, criticized the "erroneous philosophy" which argues for the kings being subjected to the will of the multitude (by means of the concession of constitutions), transforming them into "temporary representatives of the people" with no "superior" investiture. With the remarkable insight which characterized some Reactionary Catholic writings on society, Ventura noted in the same speech that philosophers aimed to banish "the monarchies from society as well as God from the universe". In fact, the non-constitutional, absolute nature of God's power had been very clearly stated by his *maestro* Fergola. One should note how the apparently secondary topic of miracles was in fact one of those crucial issues where theological, political and empirical considerations converged. The absolute power of God is defended by appealing to the contingent nature of empirical laws, and it is used as a legitimating model for the power of the sovereign. If God himself does not rule the universe "as a constitutional king", then King Ferdinando I was legitimate in abolishing the 1812 Constitution of Sicily[113]. The epistemological side of this argument goes like this: there cannot be absolute certainty about empirical matters; in the study of nature one can only rely on induction and this knowledge will be always probable and conjectural —it can only enjoy some degree of "moral" certainty. The same holds for the sciences of politics and society. These are not sciences like the mathematical ones; and it is not a question of degree of certainty: the certainty they can rely on is essentially different. Knowledge can be acquired in these sciences not through the application of mathematics (as claimed by the Jacobins), but rather through the study of previous experiences, of the specific political tradition of our country, and through the acceptance of the principle of authority (which is metaphysically grounded). Fergola provided a battery of scientific and mathematical arguments for limiting the use of mathematical reasoning to very specific areas of knowledge, de-legitimizing its use in the "moral sciences". And this in the 1790s, precisely when they were most needed by counter-revolutionary authors. Needless to say, Fergola's scientific production was perfectly in line with the French Traditionalist and Reactionary Catholic strategy of showing, through philosophy and history, the essentially passive and limited working of individual reason.

Let us go back to Fergola's remarks on science and religion. He emphasizes the difference between "physical necessity" and "absolute necessity" (which coincide with what others called "moral" and "mathematical" necessity)[114]. The first is hypothetical, depending on our ability to make inductive prevision about natural phenomena; this is what is broken by miracles. The consequence is that miracles do not break any absolute necessity, but only a hypothetical one. When discussing the nature of miracles, Fergola remarked that the ways in which nature "really" works are simply ignored by humans. "Who has understood how the gravitational force works?" he asked, " or the transfer of motion from one body to the other? [...] Thus, to investigate the way in which the omnipotence of God produces a miracle, is an insane and rash enterprise". Other interesting fragments regard the impossibility of "proving" the mysteries of religion; and the pride of atheist physicians, "who believe they are the only philosophers of the micro-cosmos [the human body]", and reject any possibility of supernatural intervention.

This series of aphorisms is followed by a short essay —an "apologetic speech"— in defense of Saint January's miracle. The work was directed against "the atheist and the deist". In fact, because of its popularity, this specific miracle had been critically analyzed by a number of French *philosophes* —including Voltaire— and, later, it had been attacked and "de-mystified" by Neapolitan Jacobins (namely by some of Lauberg's students). During the eighteenth century, the miracle, which allegedly takes place yearly in the Cathedral of Naples, had become the symbol of the superstitious religiosity of the Southerners. Fergola went to the Cathedral, made a series of observations and took notes. The results were the following: the miraculous liquefaction of the blood took place in very different climatic conditions; which rules out all the "natural explanations" based on such factors as temperature, pressure and so on. When it comes to the positive argument in support of the miracle, Fergola, very interestingly, adopted a strategy which was to be most important in the texts of the French Traditionalists and of Reactionary Catholic authors. When dealing with moral truths, Fergola argues, human beings can be suspicious and skeptical *only until a certain point*; if we do not limit in some way our inclination to be skeptical, than "every moral certainty would be suspended, and as a result society would be destroyed"[115]. The one who looks for absolute certainty outside mathematics —and relies only on individual reason— is a danger to society. At some point our questions must end: and this is where authority and tradition begin.

The book is closed by some "thoughts about philosophy and religion", extracted from Fergola's manuscripts. Here Fergola returned to the separation between pure mathematics, where absolute certainty is attainable by human reason, and the "physical-mathematical sciences", the mixed mathematics, where we can only rely on degrees of probability. This depends on the fact that in the natural sciences we employ mathematical symbolism, but only starting from hypotheses which are not themselves certain. And the more complex is the object of a science, the more we have to rely on hypotheses. Other aphorisms hinge on the nature of the "primitive forces" of the universe, which will always remain completely unknown to the deepest philosophers. The limitations of human reason also recur in the aphorisms. The fact that even in Euclid and Archimedes one can find uncertain principles (like the postulate of parallels) shows that "there is no certainty in human knowledge". At the same time, Fergola defends the sciences from the ignorant critics that in every age have attacked them without any real comprehension of them (he referred to the Phyrronists). In his notes about "a plan for a proof of the existence of God", Fergola compares different cosmological hypotheses taken from the history of philosophy. He criticizes the Cartesian, the Leibnizian, and especially the Epicurean —materialistic— one. From empirical observation we know that the universe has been created by an "excellent geometer", and this cannot certainly be "blind chance". The fight against the atheist-materialist continues over themes such as the relation between mind and body, which to Fergola means the relation between spiritual soul and material body. To him, the greatest blasphemy is precisely reducing thoughts to matter and motion. Atheists, Fergola wrote, "consider feelings like motions"[116]. In reality, Fergola says, the body "cannot infuse any new virtue in the spirit". Spiritual phenomena (which include intellectual activity) cannot be explained by physics and physiology. The clash with the flourishing Neapolitan *ideological* tradition could not be neater. Fergola concluded by noting that a (negative) answer to the old problem of whether a society of atheists could ever exist has been finally provided by the most recent historical events.

These forgotten and unsystematic remarks are also the only place where Fergola explicitly provides hints about his own version of the structure of knowledge. We can sum up our previous remarks while trying to present such a structure. Human beings have three cognitive faculties: they know through their *faith*, through their *intellect* or through their *senses*. Correspondingly, the realm of human knowledge divides into three main branches: religious knowledge, mathematical knowledge, and empirical knowledge. Each branch —here is the crucial point— enjoys different epistemological criteria, and in each branch a different kind of certainty can be obtained. The aim of the reformers and of the Jacobins was precisely the abolition of such a dis-homogeneity in epistemological criteria and methods through the expulsion of supernatural knowledge from the realm of legitimate knowledge. Fergola's structure is a reaction, on a new and consolidated basis, against this attempt to secularize knowledge[117].

So, in the first and fundamental branch, that of **religion**, the legitimate source of knowledge is the authority of the Church (which derives directly from God) and of its tradition. Individual reason cannot be permitted to put dogmas in question. Applying human reasoning to such issues is making a fundamental conceptual error. The second branch, **mathematics**, is where reason can legitimately exercise its function, and it can indeed reach here its highest achievements. The "art of geometrical discovery" is defined by Fergola as "the most beautiful dianoethic virtue", which, in scholastic terms, means intellectual virtue. Still, one should note that Fergola has in mind a *sui generis* conception of human reason. The highest achievements are obtained in geometry; here the *evidence* of the relation among certain specific figures forces human reason to assent to certain propositions about those figures[118]. Geometrical truths are indeed the very paradigm of *evidence* and *clarity*. One *sees* them; the knowledge about them is immediate, as it is not-mediated by any form of symbolic knowledge. The acquisition of geometrical knowledge is always associated with visual metaphors and with the act of looking at the figures. Solving a problem is seeing how to analyze it, i.e. how to reduce it to simpler geometrical constructions. Proving a theorem is seeing that certain relations among figures hold. It is impossible to think of geometry without figures —but the Lagrangians, Lauberg and later Padula were suggesting precisely this. As we know, figures and constructions are crucial to Fergola and his school, as geometrical reasoning can only happen by looking at figures. Any use of symbolic methods, like algebra, must in the end reduce to something that is visible in figures. The boundaries of the science of geometry are traced by Fergola on the basis of this epistemological limitation of geometrical reasoning. As it emerges clearly from both his published and unpublished material, Fergola thought of the symbolic reasoning of algebra as being essentially different from geometrical reasoning. Now we see this is because of the kind of non-mediated evidence enjoyed by geometrical truths. This evidence is qualitatively different —superior, in fact— with respect to the evidence enjoyed by truths discovered by means of forms of symbolic knowledge. In symbolic knowledge, algebra for instance, evidence is mediated by the instrumental apparatus made up by an alphabet of signs plus the formal rules to manipulate these signs. Evidence is somehow "hidden", it remains there —beyond the symbolic dimension. In fact, Fergola has always praised the power of algebra and calculus as heuristic methods, as methods to discover geometrical truths, but he has also stressed that these findings have to be somehow confirmed by geometrical intuition, which can be done through the unusual and typically Fergolian techniques of translation of symbols into geometrical magnitudes. We have seen this approach in the first part of this study; now we can see which kind of epistemological conception brought Fergola to this particular approach to geometry, and mathematics in general. In his typical pre-Kantian and pre-modern axiomatic approach, Fergola saw the science of geometry as the result of an operation of intellectual abstraction of "pure forms" from the contemplation of empirical reality. The relations among these forms enjoy a necessary nature and they are known by the geometer with absolute evidence. How does human reason work in geometrical reasoning? Its working is essentially passive: firstly, it abstracts forms from the contemplation of nature (but what is this if not a refined form of "mirroring"?); secondly it sees with evidence the relations among abstract forms (but such an evidence is in things themselves). Reason "discovers" geometrical truths in the sense that it *recognizes* geometrical truths. The essentially passive nature of such a process of discovery is continuously underlined by the all-pervasive visual metaphors. Even the immediate, intuitive recognition of geometrical truths, as opposed to other forms of non-intuitive reasoning, support the argument of a non-creative contribution of reason to geometric discovery. Though, geometry is where human reason can achieve "its highest results", it is the art of discovering geometrical truths which is the "most beautiful intellectual virtue". By contrast, when calculating the values of a certain function, human reason is not *seeing* anything, it is not mirroring anything; algebraic language is artificial, it is a human invention, it is a *creation* of human reason. Here is the point, I believe. Human reason works at its best when it reflects, through intuition, the order of a supernatural reality. But when human reason tries to create an order by itself (such as the "analytic order"), then nothing good can be expected out of this blasphemous act of pride (as "creation" is only for God). Where should the objectivity and certainty of algebraic reasoning come from? They could only come from human reason itself, but we know how weak and impotent human reason is (it is "a trembling light in the darkness"). It can hardly recognize truth when it sees it, how could it create true knowledge out of nothing? Now we can better understand some of the obscure claims contained in Ventura's eulogy of Fergola. They were not purely rhetorical statements: Fergola saw God behind triangles and circles, whereas the haughty algebraists saw the nothingness behind their formulas. The geometrical knowledge of Fergola was grounded on his intuition-vision-recognition of divine truths; the algebraic knowledge of the analytics has been created out of their own minds, it is not grounded on anything real.

We can finally move to the third branch of knowledge, the **empirical and moral sciences**. If faith is a "much nobler" faculty than intellect, the achievements of intellect can only be palely resembled by those of the senses. The most spiritual part of human reason works at its best when dealing with pure geometrical entities, because of the evident nature of their properties. When it comes to empirical matters reason has to deal with much more complex situations, where the components of facts are indefinite, and their properties are mostly unknowable to human beings. No wonder that geometrical reasoning is inadequate to acquire knowledge about empirical reality; other forms of reasoning, such as induction or probabilistic considerations seem to work much better here. Of course the methodological change yields epistemological consequences, as leaving geometrical analysis behind one also leaves certainty behind. Human knowledge about empirical reality can only be conjectural; the divide from geometrical knowledge is not of degree, but of kind. In the empirical sciences there are variations of the degree of certainty: physical sciences are partially mathematizable, as their objects are relatively simple and abstract; moral sciences are much less like that, and the sciences of politics and society are completely non-mathematical, as their objects are indefinite and very complex. In a more metaphysical language, like that used by

Fergola, Colangelo and Ventura, one could say that while pure mathematics (geometry and geometrizable calculus) is a "pure", a "spiritual" science —as it is knowledge acquired by intellect alone— mixed mathematics, where mathematical formalism is applied to make sense of physical phenomena are "material sciences", because knowledge is acquired by mixing mathematical reasoning with empirical considerations, i.e. with "matter". This can help us to understand other obscure passages where Colangelo and Ventura accused the *philosophes* of "materializing" mathematics, whereas Fergola always made it a "spiritual" science. The distinction concerns the objectivity of knowledge (certainty vs. probability), its epistemological features (intuition vs. calculation), and its moral connotations. Moral indeed, as using mathematical reasoning improperly, as the *philosophes* and the Neapolitan Jacobins clearly did when they extended their calculations to morals and society, is deeply immoral. Firstly it is a sign of the most blasphemous haughtiness, as individual —secularized— human reason is thought to be powerful enough to explain the working of the entire universe without the support of religion and authority; secondly it breaks the natural boundaries of knowledge, as empirical knowledge is no field for the use of pure intellect. About the boundary-breaking, one can note a passage where Flauti condemned the work of the Neapolitan analityc geometers by saying that theirs was only "hybrid progress". The deeply negative moral connotation of the Greek term "hy'bris" (which in the classical literature meant precisely the blasphemous action of breaking a natural-divine order of things) was here used with an emphasis which could not escape the classically-educated members of his school. Fergola, according to his biographers, was the "pure" mathematician who restored science in Naples. Pure was his devout and semi-monastic life; and pure was his science and his mathematics. The virtues of faith (humility and detachment from material things) simply made his scientific knowledge greater and deeper, showing that only a truly Christian can be a truly scientist.

When describing the Jacobin structure of knowledge, I referred to Cestari's epistemological work. I was wondering where an explicit representation of the Reactionary Catholic structure of knowledge could be found when I visited the famous Library of the Neapolitan Oratory. And the best representation was precisely there, in the middle of the Rococo ceiling of the great reading-room. It is a fresco of the first half of the eighteenth century, when the Library was restored and its anti-modern activity began. It is clearly a "Triumph of Faith", a rather common subject of the period, and I would suggest that its model was possibly the well-known fresco painted by Francesco Solimena (1657-1747) in San Domenico Maggiore. But, unlike Solimena's and many others', this is not a triumph of faith against heresy. Instead, as it clearly appears from the allegories, it is a triumph of faith over scientific error.

Surrounded by the portraits of the most illustrious Oratorian scholars is an oval. This contains a vertical representation of knowledge which contains a spiral movement from top (God) to bottom (Error). Let us follow it:

1- top, right: behind a cloud is the throne of the unknowable God. We know he exists, even if we cannot *see* him; i.e. our reason is too weak to understand his nature. Angels testifies of his presence: we know about him through testimony (authority, tradition), not through reason.

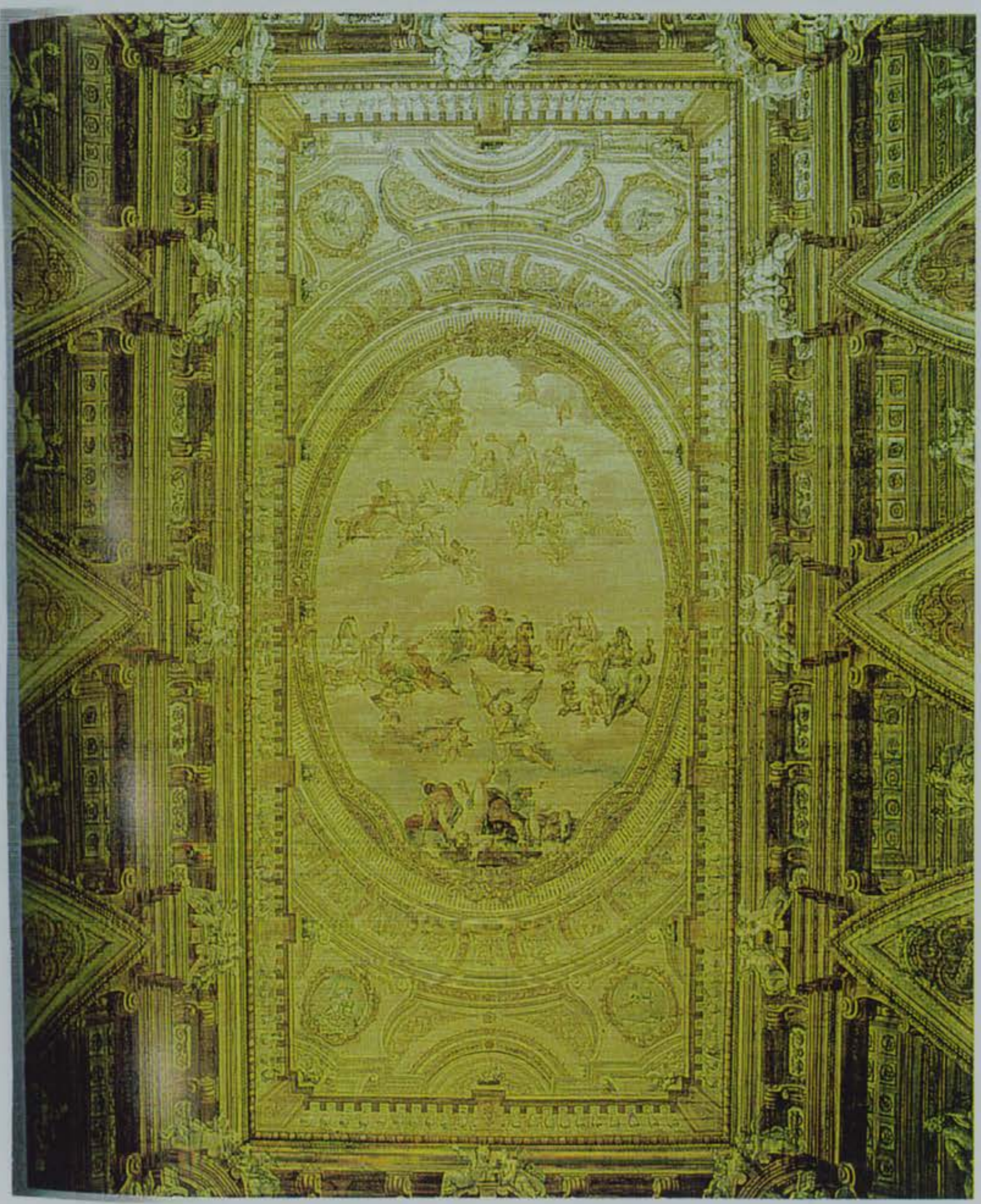
2- slightly below, left: allegoric representation of Faith. It is an aged woman with a severe expression; on her left shoulder is a great wooden cross, in her right hand a golden chalice. She is stretching her left arm in the direction of a group of contemplating figures.

3- slightly below, right: group of seven allegoric figures. From their symbols it is clear that they are the sciences (golden circle, lamp, mirror) and the virtues (silver shield, water, scale);

4- below, inferior part of the oval: group of four allegoric figures. They are the continents, to signify the entirety of creation. In the middle of them an angel strikes some giants who fall to the ground.

Once having identified the allegories, the meaning of the representation is quite straightforward. Faith receive its truth from God himself; in turn it enlightens the sciences and the virtues. They are of no value if not guided by faith. The whole world receives civilization and progress from the sciences and the virtues provided they are enlightened by faith; the angel of God attacks error and put it to flight, by means of true science (golden projectiles, probably arrows).

Not as masterfully executed as Solimena's fresco, the Oratorian fresco was painted by lesser known artists, and the creator of the design is unknown[119]. Nevertheless, it is an important document in the history of knowledge, as nothing



could better express the structure of scientific knowledge which was shared by the scholars who worked against the secularization of the sciences in late eighteenth and early nineteenth century Naples.

5.5 Other Adherents to Apologetic Empiricism

Fergola's school was the main center of elaboration of anti-modern scientific thought in Naples. Its mathematical practice and theory was shaped on the basis of the anti-modern structure of knowledge adopted by Reactionary Catholics. However, Fergola was not alone in supporting what we called "apologetic empiricism". I do not refer here to the metaphysical philosophers of the RUN, such as Capocasale, who wrote texts of Newtonian physics which were inspired by Fergola's textbook during the period 1790s-1830s. I refer instead to some devout — but secular— natural philosophers and physicians who worked in the framework of apologetic empiricism since the 1770s and 1780s, contemporaneously with and independently of Fergola. This fact strengthens our hypothesis of a mobilization of devout and loyalist men of science against the secularization of knowledge and society.

A couple of cases provide evidence for the existence of this "other science", which was not linked to reformist, egalitarian, and democratic programs, much less to revolutionary ones. My goal is twofold: to substantiate with further historical material what has been said about the theoretical features of apologetic empiricism; and to provide historical evidence for the diffusion of this anti-modern conception of science, which has never been recognized as such by historians of Neapolitan culture. The idea that in 1799 scientists and physicians defended *en masse* the cause of freedom and democracy has been maintained, with some reason, by nineteenth century liberal historiography, and it has been accepted uncritically up to now. In fact, there was an important part of the Neapolitan scientific intelligentsia which disagreed with the reformist-revolutionary goals, and whose scientific work was relevant to the elaboration of Reactionary Catholicism.

The first case is that of Domenico Cotugno (1736-1822), the most famous physician in late eighteenth-century Naples. His work is best analyzed by contrasting it with that of Domenico Cirillo (1739-1799), the physician whose work inspired the reformer's "epistemological unification" of the human and physico-mathematical sciences and the secularization of knowledge. Even the most recent historiography does not hesitate to place Cotugno's work side by side with that of his friend and colleague Cirillo. The fact that Cirillo ended up hanged in Piazza Mercato in 1799, whereas in the same year Cotugno was in Palermo with the royal family and was to die a very rich man in 1822, is explained by a mere difference of temperament. Ferrone places Fergola in the conceptual area of the reformist front, only noting that he was unusually devout; similarly Cotugno is placed together with the many reformist-Jacobin physicians, only noting that his should be regarded as a case of "Catholic Enlightenment". This classification seems to me extremely confusing. If Cotugno and Fergola can be classified as exponents of a so-called "Catholic Enlightenment", than it becomes difficult to see what was *not* Enlightenment. The rationale behind this classification seems the following: men and women of science were on the side of Enlightenment. Once again it is Mannheim's position, which has been internalized by many historians of thought: their hidden assumption is that those scientists whose value was widely recognized in Naples and abroad couldn't be working against Enlightenment. If some philosopher and scientist was committed to political reaction, this must have been some unproductive and pedantic figure, *à la* Capocasale, whose scientific work was certainly distorted and biased. A presupposition which clearly derives from the *a priori* assumption that Enlightenment scientists were not biased in their production of scientific knowledge.

Cirillo, favorite scientist of Pagano and Filangieri, correspondent of Voltaire, d'Alembert, Diderot and Rousseau, had introduced the works of Linneus and Lavoisier in Naples. Through the conceptual framework of Lavoisier's chemistry he had studied vegetal physiology; he had also claimed that it was possible to experimentally ground morals upon human physiology. Through his work, he showed how religious belief should remain extraneous to scientific research and political activity. His last public duty was in the Legislative Committee of the Neapolitan Republic, and this cost him his life. Cotugno's career was parallel to Cirillo's. They were almost the same age, they studied in Naples in the 1750s with Genovesi, and they entered the university in the 1760s. They worked at the Ospedale degli Incurabili, the greatest hospital in town. They both became renowned for their experimental ability in the field of, respectively, human anatomy and biology. Cotugno held the chair of Anatomy from 1766 to 1818; and thanks to his personal success the chair became a "primary chair". He was a pensioner of the RAS since 1779, and later its president (1808-1817); he was also Rector of the RUN and physician of the royal family. The author of a recent study remarked that Cotugno "remained always extraneous to active politics and he professed a neutral and a-philosophical conception of scientific knowledge"[120]. His most important works were a study in the physiology of the auditory organ, and one physiological and clinical study on sciatica[121]. In the first one, Cotugno provided an extremely minute description of the vestibule, the semicircular canals and the cochlea of the osseous labyrinth of the internal ear, on which basis he claimed that the labyrinth was entirely occupied by fluid. This went against the common assumption that there was air in it: according to the traditional view, fluid was not capable of transmitting sound-waves[122]. Cotugno provided in fact a new theory of resonance and hearing, grounded on his morphological observations. A lively debate arose from the diffusion of Cotugno's discovery, as most European physiologists —including the much respected Albrecht von Haller (1708-1777)— rejected his observational data. Only in 1863 was the phenomenon of hearing consistently grounded on the dynamics of labyrinthine fluid by Hermann Ludwig von Helmholtz (1821-1894)[123]. The same spirit of observation is to be found in the microscopic study of the sciatic nerve —the first indeed, and in his later studies on the nature and diffusion of smallpox and pulmonary tuberculosis. Every research, according to Cotugno, must depend primarily on the observation of the human body. Medicine not being an exact science, can only be grounded on observation and experience. Cotugno exploited Genovesi's anti-metaphysical arguments to make his point about the need for empirical research and for avoiding the abuse of reason. The Genovesian resonance and the remarkable scientific achievements have been enough to place Cotugno in the tradition of Neapolitan Enlightenment. But the essentially apologetic nature of his boundary-tracing strategy emerges clearly as soon as we look at his epistemological works. In his speech *On the Spirit of Medicine*, read in 1772 at the Ospedale degli Incurabili, Cotugno addressed the young entering the profession. Medicine is "a very difficult art", but knowing "its spirit" can make it much easier to keep the right direction in its practice. Remember that talking of "the spirit of analysis" was very common among French *philosophes* in those very years. What is "the spirit of medicine", then? "Medicine" Cotugno said, "is not a science, it is mere empirical knowledge [*cognizione*]"; it is not "a human invention", instead it "derives from facts": nature itself "dictated its precepts". Medicine is "an art taught by Nature only. This teacher wants to be heard, not overcome; it wants to be known, not understood". Nature must be observed with "pure eyes"; "there are no masters in medicine", but nature. The object of medicine is the human body, "a marvelous piece of work" whose delicate and complex harmony is often affected by external factors. Since antiquity, treatments for diseases were grounded on instinct, trials and errors, and analogies. This pragmatic heuristic should still be the basis of medicine, which is an essentially inductive and fallible practice. The physician should never think he has reached the truth, nor can he extend his remedies on the basis of unlimited analogic reasoning, as "Nature is so free and masterful in its productions, that at each step it wants to be known in its particular objects, and it has employed a specific law and specific dispositions in every one of its productions. It seems almost that it wanted to show us its great power"[124]. Consequently, it is not enough to examine some of its productions to judge about any other. Cotugno notes differences and draws epistemological boundaries where others had seen the possibility of generalization and laws, and the universal application of analytic reasoning. Applying the heuristic methods of exact sciences to medicine is instead erroneous and damaging. The early —purely empirical— practice of medicine was, in more recent times, subjugated by the "despotic rule" of reason. The philosophers, the self-declared "priests of Reason", picked up the results of the previous experiences, the "pure truths", and put them under the "yoke" of reason. One began to hear about "disputes" and "causes", and as a consequence of these "metaphysical errors", medicine became more obscure and less useful. "The unhappy epoch of medicine began when, leaving to the common people the study of the effects of nature, men became interested in the study of causes". Since then, "one began to hear about systems, and in an art where only particular laws are employable to make sense of particular cases, one heard of general laws", which were extraneous to its nature[125]. The good physician regards as more important "diligence in observing, than subtlety in understanding". In Cotugno the return to the ancients meant precisely a return to a practical, observational medicine, to the spirit of Hippocratic medicine. Cotugno's anti-intellectualism found its expression in statements such as: "what is the point of debating so much when this is not needed? Medicine needs facts, not words"; or the examples of admirable peasants observing nature to treat themselves and their families, as opposed to "the subtle metaphysical physician". Only goal of medicine is treating diseases and reducing pain; it provides us with no certain knowledge about the infinitely complex "human machine". Certainly, reason is the faculty which allows us "to perfect our cognition", but "it should know its own limits". It cannot know the first causes, and "it cannot reach by synthesis their effects" (i.e. no deductive knowledge is possible about nature). Medical knowledge must be limited to "facts", i.e. the effects of those "first causes" which will always escape human reason; "we cannot know about causes: our knowledge can only be about phenomena". Human reason can be legitimately used "to know, to examine, to confront, to calculate physical effects". The jump from the chain of effects to causes is beyond its capacity. Medicine, as stated by Hippocrates, only admits purely empirical knowledge: its "spirit" is that of being a matter-of-fact knowledge[126]. And this is why anatomy, the true description of the structure of human body, is the basis of medicine, and physiology, the knowledge of the "motions" of the organs (whose harmony must be maintained) can only be founded on anatomy.

In another speech at the RUN (1778), Cotugno treated of the way to prepare the spirit for scientific investigation[127]. "Wisdom" is to Cotugno a virtue, perfected through education and custom, which allows humans to know and follow truth, as it includes both erudition and practical action. So he can claim that "the safety of the state is in the wisdom of its citizens", as it provides a safe guidance to practical life. "It is clear that doctrine does not yield wisdom if it is not conjunct with virtue"; more precisely doctrine without virtue is dangerous, as "human reason tends by nature to abuse its forces if customs do not restrain it". A state where sciences are flourishing but customs are corrupted cannot be safe: "how can we have civil tranquillity without honesty, faith, continence, truth?" Moral integrity and intellect reinforce each other and progress together, the sciences being "the eye of society", and its collective memory.

Truth is difficult to access though, and the human spirit (*animo umano*) needs a special training to recognize it: this is provided by "meditation". Spirit is described by Cotugno as a celestial element imprisoned in the human machine, the body, as if it were "in the fog". Recognition of truth demands a great effort, which Cotugno describes as articulated in "attention" and "meditation", where the spirit concentrates on itself, and detaches itself from the body. Bodily abstraction proves crucial, as the control of sensible pleasure is necessary to the recognition of truth. This has been given to guide man to the investigation of the universe (pleasure of observing the sky, or the varied earthly phenomena), but human spirit easily becomes a slave of these pleasures and does not accomplish the second, crucial step: to recognize the existence and attributes of the "author of the universe" from phenomena. "The images of objects we obtain through the senses are like seeds deposited in our spirit to fecundate it and to let it accomplish its goal, which is to know God and the utility of the existing beings". Cotugno described the practice of meditation as the observation and confrontation of "mental images", which are stored in "the very sensible fibers of the brain". The spirit not trained in meditation will be easy prey for passions during adult life, as passions emerge from the lack of intellectual control on these fantastic images and their resulting disorder. Meditation produces the excitement of specific brain fibers, which "enlighten" the specific ideas to be contemplated. The spirit receives the images, compares them, and deduces consequences from of them (i.e. proper, active *reasoning*). This controlled intellectual activity, and the subordination of fantasy to intellect, causes positive material effects on the brain, which strengthens and perfects it. Cotugno made a number of empirical observations on the activity of the brain in humans and animals, and he concluded that during meditation the influx of blood is limited, and the global excitement of cerebral fibers is diminished: this physiological state correspond to the activity of the brain being in full control of the superior spiritual component. Cotugno wanted his students to practice constantly meditation as, in fact, "human nature has reached such a state of depravation that the body, born to obey, contrasts the rule (*imperio*) of the spirit, and often reduces it to a shaming slavery"; only a correct and effective education of the young can restore the lost equilibrium. "Civil education will form the morals, literary education will produce the doctrine: if they do not proceed together, everything is doomed".

The speech, re-printed in 1786 and 1834, sums up the epistemological ideas of Cotugno; it also sheds light on his choice of certain specific fields of investigation such as brain activity, sensory organs and nervous system. The very episode of his description of the labyrinthine fluid, and of his new theory of hearing, could probably be fruitfully investigated by connecting it to its ideas about the "vibration" of semi-fluid brain fibers when excited[128]. Among his basic philosophical points are: the epistemological limitations of human reason, the rigid duality of spirit and matter and the supremacy of the spiritual over the material, a teleological conception of the human body, a crucial role for final causes in empirical explanation, a providential view of the universe, the eulogy of "wisdom" (a holistic form of religious-moral-intellectual knowledge), which implies the rejection of the secularization of knowledge, which is indeed a unitary body whose parts are functional to the elevation of man to God. About scientific practice, we find suspicion towards philosophical systems, and a phenomenal conception of empirical reality, a methodological empiricism: "pure" observation of nature without *a priori* theoretical commitments. But we already know that this extreme empiricism is far from being contradictory to the metaphysical dimension just highlighted: they are instead perfectly complementary, as they were for Colangelo, for Fergola and for Capocasale. By the criteria we have been defining in this study, Cotugno's work in medicine cannot be assimilated to that of Cirillo or of other reformist-revolutionary physicians; it was instead functionally and structurally analogous to that of other devout anti-modern scientists.

Lastly, I will offer some remarks on the work of the natural philosopher Giuseppe Saverio Poli (1746-1825) whose name was well known in Naples at the turn of the century. After obtaining a degree in medicine from the prestigious University of Padua in 1770, Poli exercised the medical profession in his native town of Molfetta (Apulia), but he soon devoted himself to the study of the natural sciences. From 1776 he held the chair of history and geography at the Military Academy of Naples[129], while giving courses of experimental physics to the students of medicine at the Hospital of the Incurables. He later became professor of experimental physics at the RUN, and Director of the Military Academy. His name figures among those of the founding members of the RAS where, in the 1780s, he read memoirs about his experiences on electricity. Like Cotugno, Poli enjoyed the trust of King Ferdinando. This resulted in his being chosen to be the tutor for Prince Francesco, and in the generous support for his scientific travels and for the acquisition of scientific instruments. In fact Poli traveled all over Europe to meet famous scientists and to familiarize himself with their research and their didactic methods. Particularly important were his contacts with the British and French "physicist-electricians", as he called them, and with Benjamin Franklin, whose theory of electricity he defended in Naples. He was a member of the Royal Society of London, the Academy of Philadelphia, and a number of Italian academies including those of Siena, Turin, and Bologna. Thanks to the support of the Crown, Poli was able to promote the study of the sciences in Naples with provisions such as the opening of the Royal Bourbon Library to scholars, the foundation of the Botanical Garden of Naples, and the donation to the Museum of Natural History of a number of rare pieces (some of which he had bought from James Cook[130]). Poli's main work is a monumental study on Mediterranean crustaceans and mollusks, published in two magnificent folio volumes and enriched with over sixty copper-plates[131]. He presented for the first time a complete classification of this branch of zoology, articulating and completing Linneus' scheme. Through his meticulous observations Poli was able to describe the morphology and the functioning of the organs of these animals, and he is credited with a number of relevant discoveries.

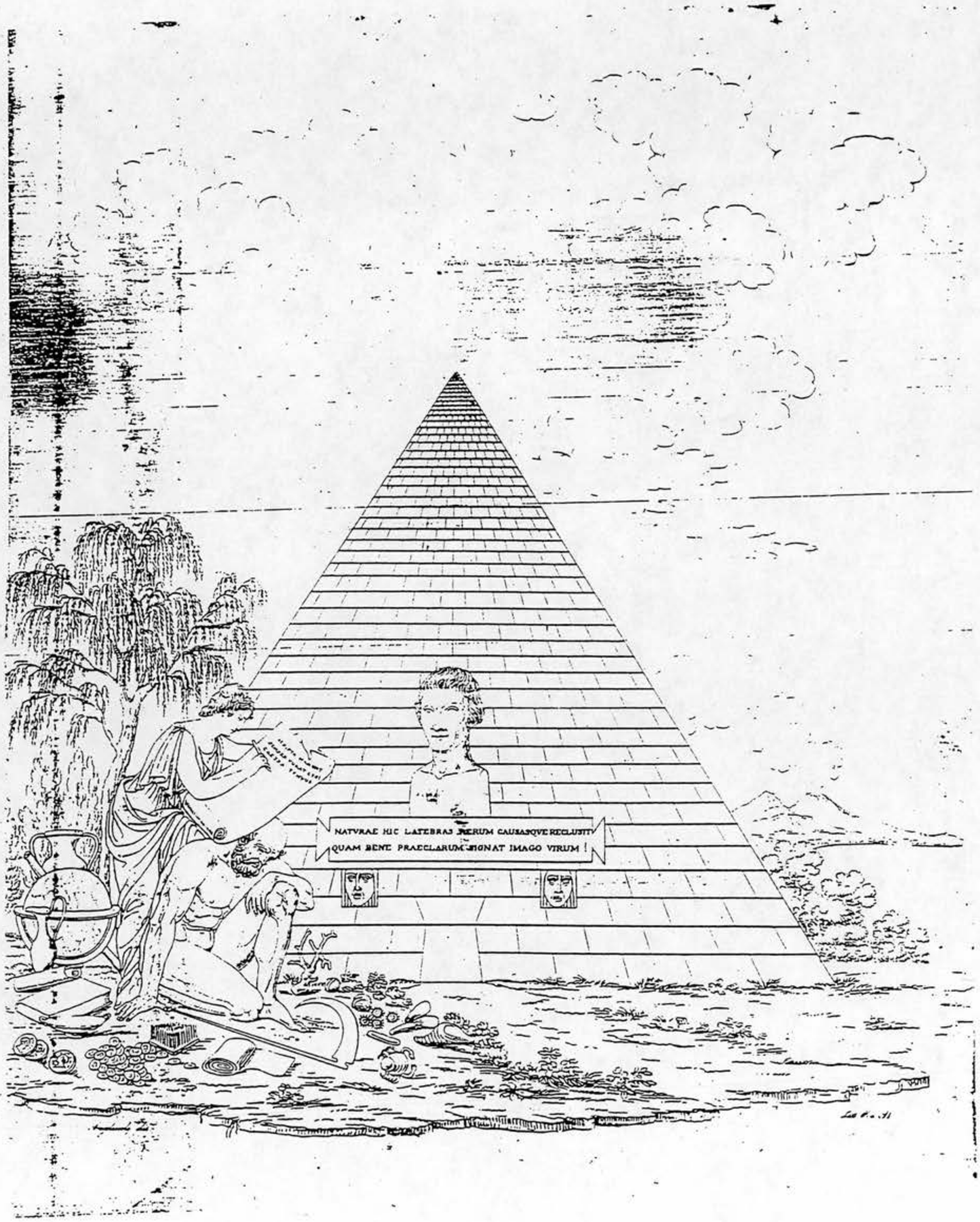
No historical work has been done on Poli, in spite of the fact that his research and memoirs, published between the 1772 and 1805, were well known in Naples. In particular, his textbook of experimental physics was the most successful and widely used in the kingdom for at least thirty years[132]. It was firstly published in 1787, and I have consulted the sixth edition, published in 1822, where the author claimed that his five previous editions, plus some others edited in Naples and abroad, all "went rapidly out of print". In fact, most of the lecturers of philosophy teaching in Neapolitan private and public schools between the 1790s and 1820s used Poli as a textbook[133]. Why was it so popular? For a start, the book was written by an enthusiastic and refined experimenter, not by some tedious metaphysician such as Capocasale; at the same time, it was more intuitive and elementary than Fergola's mechanics, which was specifically designed for students of mathematics. But one should also note that Poli's textbook presented a very peculiar feature for an eighteenth century book of experimental physics: it does not contain one single mathematical formula. Which is not to say that it was out dated; the sixth edition contained "remarkable additions" where the most recent experimental results described in the acts of various academies during the 1790s were presented to the student in plain Italian and with the aid of figures. This unusually long textbook (five volumes) covered a number of phenomena and disciplines: matter, motion, cosmography, mechanics, hydraulics, air, gases, sound, water, caloric, light; the lion's share (more than three hundred pages) being left to Poli's favorite topic, electricity, which included the phenomena of magnetism and Galvanism. For each natural phenomenon an account of current competing theoretical explanations was provided, highlighting their respective advantages and deficiencies (no space was given to the history of science and to the ideas of the ancients). Then Poli described accurately those experiments from which the properties of the phenomenon had been best clarified. His account of the debates over the nature and properties of electricity, from the Nollet-Franklin-Symmer controversy to the more recent Galvani-Volta controversy over "animal electricity" is worthy of remark[134]. Poli claimed that, on the basis of the described experiments —he himself had been experimenting on electricity since his years in Padua[135]— he is inclined to follow Franklin's theory of electricity; and in general he cautiously defended a view according to which the "electrical fluid" produced by electrical machines was an analogous phenomenon to magnetic and Galvanic fluids[136].

A physician himself, Poli gave space to the medical applications of electricity and magnetism, which were also the objects of some of his academic memoirs. While dismissing Mesmer as a "charlatan", he defended the use of electrical machines to treat specific pathologies related to the difficult circulation of the "internal bodily fluids", as he attributed to electricity specific fluid properties. Interestingly, while describing the "noble contention" between Volta and Galvani, Poli remembered an experience made by his friend Domenico Cotugno, who well before Galvani's experiment with the frog, had written about receiving an electric discharge during the vivisection of a mouse[137]. Poli himself repeated all of Galvani's experiments on frogs as soon as he received their description from Bologna[138]. Note that, when describing an experiment, Poli gave also precise information about the cost of the necessary devices and the shops in Naples, Paris or London where they could be ordered. From such a sketch of Poli's life and interests, there emerges the figure of an enthusiastic experimenter, entirely devoted to observation and data collection, reluctant to take any sort of theoretical commitment, and with no interest whatsoever in the turbulent political life of the period. This was also the way in which he liked to present himself and his work; and this is the way in which he is described today in the biographical notes[139]. In fact, unlike Fergola, he was not the typical devout and legitimist reactionary intellectual. Nevertheless, I suggest that his own experimental approach to science was just another version of that general attitude towards knowledge, reason and science that we called have "apologetic empiricism".

Let us begin with the remarks made by two of his friends, on the occasion of his death. Note that they both were exponents of the reactionary rationalist philosophy, which was dominant in the 1820s. Giampaolo observed that, before turning decidedly to the natural sciences, Poli had deeply studied logic and metaphysics, which included the "analysis of sensations"; but he did not commit the same error as the *ideologists*, i.e. he never pretended "to know everything": to Poli the analysis of human sensations was just the first step to reach the knowledge of the creator of the universe[140]. Giampaolo also remarked that he favored the studies of physics as that is "where one admires most closely the wisdom of God"; but in fact he never stopped the study of theology, which in his mind was the supreme science, where "the real design of creation and the immortal destiny of man are unveiled"[141]. Giampaolo recognized the subtle apologetic dimension of the major work on mollusks: indeed it showed how "providential nature operates constantly and uniformly for the good of beings", and through "which steps nature advances towards animal perfection, and which are the common and different features [with respects to other animals]"[142]. The apologetic dimension is then recognized in other productions, like the textbook of physics and a long poem on the harmony of the universe. Note that in this unusual poem —where "the celestial bodies" are represented as "announcing the sublimity and glory of the divine Omnipotent"[143]— Poli had embraced Fontenelle's argument for the infinity of inhabited worlds as the most conform to the infinite power of God[144]. Also, Poli took the immense distances of the fixed stars from Earth as a good example of those "rocks against which human curiosity and pride crash"; "the most effective and reliable means by which astronomers calculate the magnitude and distances of planets, their most perfect instruments, their deepest and admirable calculations, are of no value with regard to stars"[145]. Note also the date: 1805, i.e. the period of the most effective reactionary policy: the poem was in fact an interesting point of contact between scientific knowledge, religious apology and political apology (Ferdinando is "the great and clement monarch, rich in spiritual virtue and elevate qualities"[146]). Having said that, I believe that not very many readers went through all the hundreds of pages of this deadly boring poem.

Descriptions of Poli's life followed a cliché common to other Catholic scientists (including Fergola). Giampaolo wrote that he was "modest, reserved", he remained celibate —"in peace", he disliked honors and richness, and finally "he was not in the number of the base accomplices of the secular corruption"[147]. Gatti remarked that the young Poli "resisted the flatteries of Naples"[148]; that in his lectures "he used to take any occasion to defend religion and morals"[149]; that in his textbook "he invited the reader to admire in nature the adorable hand of the creator [...], and the ends of his eternal mind"[150]. One could argue these authors were simply using Poli's work for apologetic purposes. I believe, on the contrary, that the apologetic dimension intrinsic to Poli's works cannot be overestimated. Of course, this did not prevent Poli from being an excellent zoologist, the contrary indeed: his interest in discovering the gradual teleological "ascension" of nature from the simplest form of life to the most complex ones made him look for a series of intermediate organs and functions which had never been observed in mollusks before. The general idea which gave sense and unity to his research has been represented in an engraving enclosed in one of the eulogies[151]: on the background of the Gulf of Naples, a pyramid is represented which is grounded on a terrain covered by mollusks and ends up pointing somewhere among the clouds (and we know what is behind them); on the ground are also other emblems, which recall us of Poli's many practical and cultural interests (book, globe, parchment, scythe, ancient coins and vases —of which he was a renowned collector). Allegoric figures (Atlas and Janus, apparently) stand for human empirical knowledge which is grounded on facts. The distich under Poli's bust states that he discovered many hidden natural phenomena which clearly point at the supreme being. Mollusks are the first brick of the teleological pyramid of knowledge, in which also the other various interests found their ultimate meaning.

In fact, Poli was not only the man who had proven the existence of God through mollusks, but he was also part of the restricted professorial elite which re-designed


NATVRAE HIC LATEBRAS RERUM CAUSASQVE RECLUSIT
QUAM BENE PRAECLARUM SIGNAT IMAGO VIRUM !

public education at the moment of the "return to the order", in Autumn 1799. Called by the king to enter a special commission for the reform of the university (together with three ministers and monsignor Gervasio) Poli wrote the 1805 university reform, which was approved by four representatives of the professorial order (among them Domenico Cotugno and Francesco Rossi). According to this reform, the didactic backbone ("primary chairs") was formed by three theological chairs, two chairs of law (one being feudal law), three of medicine (anatomy and Hippocratic, and practical medicine), plus the chairs of experimental physics and mathematics. Monsignor Gervasio, nominated Prefect of the RUN was in charge of approving the content of the lectures, which had to be published before being taught[152] (a provision in defense of Catholicity which was explicitly supported by Fergola[153]). Choice ecclesiastics should ensure that in the many private institutes of higher education "good doctrines" were taught (to this extent Jesuits had been called back in the kingdom in 1804)[154].

As for Fergola and Cotugno, Poli's support to the "return to order" policy went beyond his manifestations of political legitimism and religious orthodoxy. The very content of his scientific practice was indeed functional for the reinforcement of that reactionary system of knowledge we have been describing in this part of the study. Poli's extremely empirical approach to scientific knowledge and his self-limitation to remarks upon phenomena are yet another version of apologetic empiricism, in this case applied to experimental physics and zoology. A few remarks on his influential physics textbook will clarify this point. Poli's perspective is clear since the initial quote from Lactantius, a father of the Church: "human wisdom" (*hominis sapientia*) is not "knowing everything", but rather an equilibrate mixture of knowledge and ignorance: *scientia cum ignoratione conjuncta, et temperata*. Note that the awareness of deep human ignorance has the healthy function of "moderating" (*temperata*) the pretensions of scientific knowledge. And in fact a strictly phenomenal approach is all Poli recommended to his students, the rest being regarded as useless and dangerous metaphysical reasoning. In describing the properties of phenomena, Poli said he "paid special attention to distinguish between proven truths and hypothetical truths, which are grounded on mere conjectures", stressing that on most questions about nature we are in "the darkness of uncertainty". What should emerge is, according to Poli, "the prodigious simplicity and economy by which the general System of the Universe is ruled", so that from few basic principles a number of different and complex effects derive; which tells the contemplator of nature of "an infinite and inscrutable Wisdom"[155]. An argument which closely resembles Fergola's apologetic interpretation of the principle of minimal action. About the peculiarly a-mathematical form of the book, Poli remarked that he "avoided algebraic demonstrations" —which would make the text much shorter— because he wanted to be fruitfully read by all students, including those studying medicine[156]. Poli's biographers put great emphasis on the didactic advantages of his textbook: "a book for everyone" remarked Serafino Gatti[157]; while Giampaolo, in a speech at the Royal Academy, said Poli's textbook signalled a truly didactic "revolution"[158]. Such emphasis on the purely didactic rationale should be critically analyzed though. In fact, Fergola and his pupils often justified their rejection of purely analytic textbooks of geometry because of their alleged obscurity and difficulty; but we have seen how much deeper were the reasons for their rejection. Of course the didactic function of a text like Poli's mattered in the choice of the most appropriate form; but still the choice could have been different. Remember that to scientists such as Lauberg and Giordano the easiest and most natural way of thinking was precisely the analytic-algebraic one, and that they had planned an entire curriculum in mathematics and physics based on the exclusive use of the analytic method. Clearly, Poli's refusal to introduce mathematical formalism was the correct didactic choice *only if* a specific conception of scientific and mathematical knowledge was taken for granted. Such a view can be sketched as follows.

Physics, "the science of nature", studies everything sensible in "the great theater of the universe". It discovers and classifies the properties of "material substances", without trying to explain the real working of nature or the real essences of phenomena, both of which escapes our senses. "A physicist does not look for other natural truths than those suggested by facts" —wrote Poli about matter— he should not try "to discover through his imagination which are the first components of bodies, and if they can be [infinitely] divided; as such a research, which surpasses the capacities of our intellect, wastes our time and effort only to leave us in an insuperable obscurity". "The goal of the good physicist is not to form the world, but only to examine phenomena, and the laws by which they are ruled"[159]. Our ignorance does not preclude us from recognizing that the universe is a unitary, organic and harmonic structure, a "chain of created beings depending on each other", diversity and contrast only emerge in our imperfect knowledge. Interestingly Poli put among the primary properties of matter that of being completely inert and passive, so that he can later introduce the various kinds of forces acting in the universe ("affinities and attractions") as clearly disposed by "a sovereign wisdom" whose goal is to maintain the universal harmony[160]. Like Fergola, Poli declared that the physicist is "completely ignorant about the real nature of force"[161]. In fact, Poli extended this remark to each topic treated in his textbook (from "matter", to "force", to the "transmission of motion", to the "electric fluid"). "Many philosophers got tired trying to explain the nature of motion", but "no one will ever reach this goal"; about the force of gravity, "it is reasonable to suppose that it has been impressed upon bodies by the infinite wisdom of the Creator to make them work for his high ends"; similarly the faculty of transmitting motion can be thought of as given to bodies by the same wisdom, and operating "in a way that escapes the human mind". The structural impossibility of the human mind grasping the real nature of sensible things is indeed the object of a biblical quotation which Poli described as "an eternal truth"[162]. When dealing with caloric, Poli remarks that what is important is "not the ambition to discover its essence, but only the acquisition of the idea which is nearest to truth"[163]. If the physicist can investigate only natural phenomena, then "the different opinions of philosophers" over their essences "should be regarded as purely imaginary". Examples are Descartes' definition of matter as essentially extended, or Gassendi's definition of matter as essentially solid. It is quite another thing to say that matter is "inert", as this property is simply derived from experience[164].

Many errors in natural philosophy, Poli said, derive from confusing the "abstract dimension" with the concrete one: Descartes thought of extension of the essence of matter precisely because he confused "the idea of physical body with that of mathematical body"; similarly one can easily provide a mathematical proof that matter is infinitely divisible, but this proves nothing about physical objects: to believe the contrary is to mistake abstract objects with concrete objects, mathematics with physics, pure knowledge with material knowledge and, ultimately, (pure) intellect with (material) senses. So, if the indefinite divisibility of matter can be defended this has to be done on the basis of experience, not of mathematics. This is why Poli —who clearly disliked atomism— listed a number of phenomena where matter is divided "in a number of parts so great to defeat the most lively imagination" to support, on empirical grounds, the hypothesis of its infinite divisibility[165]. Here is the crucial distinction he referred to in his preface: students should grasp the *hiatus* existing between mathematical certainty and physical certainty, which are essentially different in nature. Physical certainty derives from observation and means that something is very likely to be the case, but this knowledge is essentially fallible and revisable —which mathematical knowledge is not, as it derives from the intellect observing eternal relations among abstract entities. So that Poli can tell his students: "leave aside the abstract dimension, which is the object of mathematics; do not follow the flight of imagination, which leaves you in uncertainty; observe instead what nature and art [technical devices] really offer about each specific issue" (note the metaphor of the "flight of imagination", favored by Fergola's school)[166]. Which means: always "stick to true, clear, indubitable facts, as they are the only source of human empirical knowledge [*cognizioni*]"[167]. Science is a noble and useful activity, Poli wrote, "but be careful not to become haughty, and not to assume an ultimate tone when giving your opinion on the hidden causes. Be impartial, do not follow novelty just because it is seducing, and be cautious in adopting hypothetical theories, which are simply the product of philosophers' minds". Theories can be admired, "but do not be ashamed of declaring your ignorance about what has been excluded from investigation by the Author of nature". Poli offered his textbook as an example of studying nature without taking for granted the products of "others' capricious imagination", but rather "following the trustful guidance of experience"[168].

One can now see why the didactic goal of the textbook can only partially explain the a-mathematical choice. This was also determined by a fundamental distrust in the capacity of mathematics to contribute to our *understanding* of empirical reality. It seems to me that the relevant point here is the link between such notions as "individual imagination", "abstraction", "mathematics", "fiction", and the way they are opposed to "common sense", "experience", "physics", "trustful description"[169]. Further material on this point can be found in a couple of inaugural speeches Poli gave at the Hospital and at the Military Academy[170]. Here Poli introduced the science of physics as the study of "the infinite series of bodies contained in the universe", which "convinces the human spirit of the necessity of the existence of a Supreme being, and of an infinite Wisdom who extracts from matter that great variety and that admirable order of opaque, transparent and luminous bodies through the prescription of simple laws, which He freely follows"[171]. We already know about the theological and political significance of the adjective "freely" here, and we will not return to it. Rather, note that Poli insisted on nature speaking to both intellect and feelings ("spirit and heart"), so that the more one deepens his knowledge and becomes "a trustful observer of natural phenomena", the more he knows about "his necessary duties", which are duties towards God and towards society. Poli pointed out the reason for the decline of the studies of nature "in many parts of Italy": this is the attitude of many contemplators of nature "to attribute to some new finding a much greater value and extension" than one legitimately should. The supreme task of the teacher is then that of "parting what is hypothetical from what is certain", and to teach only those doctrines "which are immediate consequences deduced by facts"[172]. This is what distinguishes modern physics from Aristotelian physics —which was obscure, speculative, useless; and this is what distinguishes, nowadays, good experimental physics from the creation of artificial "systems", which are productions of human "imagination" (*fantasia*)[173]. To sum up: if imagination plays a role in pure mathematics (where it constructs the artificial techniques of algebra and calculus), it certainly has no positive function in the empirical sciences. This is because empirical sciences, which include physics, provide us with knowledge derived from the senses, not from pure intellect; it is a knowledge about matters of fact, not about abstract, pure truths. The "creative" part of human reason is to be banished from physics, where only observation, experiments, and cautious processes of induction (always specifically oriented) must be followed. Giampaolo grasped correctly Poli's ideas about the danger of a mathematical treatment of experimental physics: Poli, he wrote "stripped as much as possible this science from the language of geometry and algebra, which often create confusion with their technicalities"[174].

Poli traced a neat boundary between mathematics and the empirical sciences, and has provided completely a-mathematical methods and criteria for them. His original passion of electricity can be possibly explained by the apparently non-mathematical nature of this phenomenon (we are referring to the 1780s-1790s). Mathematics can —to some extent— be used in physics (he said he could have written a textbook rich in algebraic formulas) but it does not provide us with a better *understanding* of natural phenomena (he simply said that it would have been "shorter"). The foundation of physical certainty must rest ultimately in sensible perception. Like Fergola, Poli was reacting to the rapid expansion of the empire of analysis over the empirical sciences with a boundary-drawing strategy based on a specific conception of human knowledge and human faculties. Accordingly, human reason is an essentially passive faculty, able to recognize certain features of abstract and empirical reality, and to reason on them. As soon as it tries to construct, to invent ("to form the universe"), errors become unavoidable. Only the awareness of the hierarchy of the different kinds of knowledge, each one with its own legitimate methods, plus the support of Christian revelation yields good science. The fact that Poli's most significant works appeared in the 1780s and 1790s shows once again how crucial this period was to the constitution of a unitary cultural reaction against the "spirit of analysis".

Notes to chapter five

1 Guido Oldrini, *La cultura filosofica napoletana dell'Ottocento* (Bari: Laterza, 1973) p.50.

2 See Oldrini, *La cultura filosofica*, pp.23-24.

3 Particularly relevant to this cultural operation were: Sigismund Storchenau, *Institutiones logicae* (Naples: 1816, note the date of publication; orig.ed. 1769); Friedrich Baumeister, *Institutiones metaphysicae* (Venice: 1789); Paul Mako, *Compendiaria metaphysicae institutio* (Venice: 1797; orig. ed. 1761). Sigismund von Storchenau (1731-1798) and Paul Mako von Kerek-Gede (1724-1793) were both members of the Society of Jesus, and most of their works had been originally published in Vienna. Storchenau published also on theology, and Mako on mathematics and physics (including a Latin treatise on differential and integral calculus published in Vienna in 1768).

4 See Giuseppe Capocasale, *Alloquutio in privato suo auditorio de logicae ac metaphysicae utilitate habita* (Naples: 1804) pp.7-9; see also the opening of his *Cursus philosophicus sive universae philosophiae institutiones* (Naples: 1824-25; orig. ed. 1789) vol.1, pp.v-xv.

5 See Capocasale, *Cursus philosophicus*, vol.2, pp.297-298.

6 See, for instance, Mariano Semmola, *Istituzioni di filosofia*, 2 vols. (Naples: 1811-12); Antonio Ciampi, *Elementi di filosofia* (Naples: 1820; third edition); Paolo Nicola Giampaolo, *Lezioni di metafisica* (Naples: 1803); Tommaso Troisi, *Istituzioni metafisiche* (Naples: 1826; third edition). Also non scholastic ideologists such as Cestari and Galdi referred to the universal chain of beings. On its eighteenth-century interpretation see Arthur Lovejoy, *The Great Chain of Being* (Cambridge, Ma: 1936); and Giorgio Tonelli, "The Law of Continuity in the Eighteenth Century", *Studies on Voltaire and the Eighteenth Century*, 1963, 27: 1619-1638.

7 See, for instance, the textbook by the clergyman Giuseppe Mazzarella, entitled *Corso d'ideologia elementare* (Naples: 1826). In 1842 Mazzarella, a pupil of Capocasale, replaced

Pasquale Galluppi at the RUN as professor of philosophy; he also wrote a *Catechismo filosofico-istorico-apologetico della religione cristiana* (Naples: 1843).
[8] See Troisi, *Istituzioni metafisiche*, vol.1, p.9.
[9] Ibidem, pp.9-11.
[10] Semmola, *Istituzioni di filosofia*, vol.2, p.244.
[11] Francesco Colangelo, *L'irreligiosa libertà di pensare, nemica del progresso delle scienze* (Naples: 1804) p.165.
[12] Giuseppe Capocasale, *Codice eterno ridotto in sistema secondo i veri principi della ragione e del buon senso* (Naples: 1827; orig. ed. 1793), vol.1, pp.58-59.
[13] Giuseppe Capocasale, *Saggio di politica per uso de' privati* (Naples: 1823) p.91.
[14] Serafino Gatti, "Lettera critica al sig. L.S. intorno ai libri apologetici della religione cristiana", in Bernardo della Torre, *La verità della religione cristiana con facile metodo dimostrata* (Naples: 1821) pp.94-95.
[15] Paolo Nicola Giampaolo, *Dialoghi sulla religione*, 4 vols. (Naples: 1815) vol 1, p.2.
[16] Troisi, *Istituzioni metafisiche*, vol.1, p.5.
[17] See Capocasale, *Codice*, vol.2, pp.92-93.
[18] Francesco Colangelo, *Riflessioni storico-politiche su la rivoluzione accaduta a Napoli* (Naples: 1799).
[19] Colangelo, *Riflessioni*, p.9.
[20] See *Dizionario biografico degli italiani*, sub voce, pp.696-697.
[21] His main work was *Istoria dei filosofi e matematici napoletani*, 2 vols. (Naples: 1833-34). But see also his *Apologia della religione cristiana* (Naples: 1818); and his *Saggio di alcune considerazioni sull'opera di G.B. Vico intitolata "Scienza Nuova"* (Naples: 1822);
[22] See note 11.
[23] Colangelo, *L'irreligiosa libertà*, p.19; the original quote was by d'Holbach.
[24]To show the plagiarism of the modern, Colangelo quotes from Diogenes, Plato, Cicero, Lucretius, Plutarch, Sextus Empiricus, Celsus, Porphyry, Julian the Apostate and many others.
[25] Colangelo, *L'irreligiosa libertà*, p.43. A tale is, for instance, that of an imaginary goddess named "Nature", which is the subject of the *System of Nature*, by d'Holbach.
[26] Ibidem, p.74.
[27]The moderns claim —as the ancient Epicureans— that matter is "various in its modifications, but uniform in its substance; necessary as a whole, but contingent in its parts; essentially provided with motion, but also immobile; imperfect and infinite; matter and, at the same time, not matter, but God" (Colangelo, *L'irreligiosa libertà*, p.85).
[28] Ibidem, p.76.
[29] Ibidem, p.84.
[30] Ibidem, p.81.
[31] Ibidem, p.266.
[32] On the apologetic use of experimental philosophy in the eighteenth century, see Simon Shaffer, "Occultism and Reason", in A.J.Holland (ed.), *Philosophy, Its History and Historiography* (Dordrecht: Reidel, 1985) pp.117-143; and Peter Dear, "Miracles, Experiments and the Ordinary Course of Nature", *Isis*, 1990, 81:663-683.
[33] Ibidem, p.288.
[34] Ibidem, p.289.
[35] Colangelo seems to like particularly a quote from Francis Bacon's *Sermo de atheismo*: "Verum est parum philosophie naturalis inclinare homines in atheismus; at altiorem scientiam eos ad Religionem circumagere".
[36] Colangelo, *L'irreligiosa libertà*, p.316.
[37] Ibidem, p.315. For a different interpretation of Newton and Cotes on gravity, see John Henry, "*Pray Do Not Ascribe that Notion to Me*: God and Newton's Gravity", in James Force and Richard Popkin (eds.), *The Books of Nature and Scripture* (Dordrecht: Kluwer, 1994) pp.123-147.
[38] Colangelo, *L'irreligiosa libertà*, p.316.

[39] Giordano Riccati (1709-1790) from Treviso, in the Republic of Venice. He was the author of *Delle corde, ovvero fibre elastiche* (Bologna: 1767), and an architect.
[40] Colangelo, *L'irreligiosa libertà*, p.319. The quote is from Antonio Valsecchi, *Saggio di confutazione del "Sistema della natura"*.
[41]"This is an eternal truth, and it has been a basic principle of the more illustrious schools, favoring the most important discoveries; all the others proofs supporting Christianity can be, in the end, reduced to this principle" (ibidem, pp.322-323). Once again, the *philosophia perennis* perspective.
[42] Ibidem, p.322.
[43] Ibidem, p.324.
[44] Colangelo, in describing the universe, employed terms derived from the language of the fine arts. Terms like *ornato* (ornate), *varietà* (variety), *disegno* (design), *leggiadria* (charm), were classical ones (mainly from Pliny's *Natural History*). They were employed in the early Italian Renaissance to describe the different pictorial styles (mainly through the works of Leon Battista Alberti and Cristoforo Landino). These qualities were related to the skills of the artisan-painter, who could decide to employ them in different proportions in order to reach a harmonic composition.
[45] "L'oeil de l'homme surpasse donc infinitement toutes les machines que l'adresse humaine est capable de produire.[...] Cependant les athées ont la hardiesse de soutenir que les yeux aussi bien que le monde tout entier, ne sont que l'ouvrage d'un pur hasard" (Leonhard Euler, *Lettres a une Princesse d'Alemagne*, quoted by Colangelo, p.332).
[46] Undoubtedly, Aristotle's theory of knowledge —filtered through the Thomistic doctrines— was a crucial source of inspiration for both Colangelo and Fergola.
[47] Colangelo, *L'irreligiosa libertà*, p.356.
[48] Ibidem, p.357.
[49] Ibidem, p.385.
[50] Ibidem, p.393.
[51] Ibidem, p.35.
[52] Ibidem, p.27.
[53] Ibidem, p.398.
[54] For a similar, "anti-modern", elaboration of empiricist themes, see Isaiah Berlin, *The Magus of the North. J.Hamann and the Origins of Modern Irrationalism* (London: Fontana, 1994). As we noted above, the apologetic use of experimental philosophy has already been pointed out (e.g. Shaffer, "Occultism and Reason"; and Dear, "Miracles, Experiments, and the Ordinary Course of Nature"). What I call "apologetic empiricism" has some similarities with Popkin's "mitigated scepticism". It should be noted that the two positions were elaborated with opposite aims (respectively, against the "scientism" of the *philosophes*, and in response to the *crise pyrrhonienne*). Moreover, the stress on the metaphysical relevance of mathematics, and on the necessity of integrating scientific investigations with religious values (e.g. humility) seems to differentiate apologetic empiricism from earlier phenomenalistic conceptions of scientific knowledge. On "mitigated skepticism" see Richard Popkin, *The History of Scepticism from Erasmus to Spinoza* (Berkeley: California U.P., 1979) pp.129-150. On late eighteenth-century scepticism, see Richard Popkin, "Scepticism and Anti-Scepticism in the Latter Part of the Enlightenment", in *Scepticism in the Enlightenment* (Dordrecht: Kluwer, 1997) pp.17-34, and Giorgio Tonelli "The Weakness of Reason in the Age of Enlightenment", ibidem, pp.35-50. On scepticism in the sciences, see Laurence Bongie, "Hume and Scepticism in Late Eighteenth-Century France", in Popkin-van der Zande (eds.), *The Sceptical Tradition Around 1800* (Dordrecht: Kluwer, 1998) pp.15-30, and Peter Reill, "Analogy, Comparison, and Active Living Forces: Late Enlightenment Responses to the Sceptical Critique of Causal Analysis", ibidem, pp.203-212. On scepticism and political conservatism, see Ian Hampster-Monk, "Burke and the Religious Sources of Sceptical Conservatism", ibidem, pp.235-260.
[55] Francesco Colangelo, *Galileo come guida per la gioventù studiosa* (Naples: 1815) p.5.
[56] Ibidem, pp.6-7.
[57] See [Nicola Fergola], *Prelezioni sui principi matematici della filosofia naturale del cavaliere Isacco Newton* (Naples: 1792-93) vol.2, p.319.

[58] Colangelo, *Galileo*, p.4.
[59] Ibidem, p.7.
[60] Ibidem,, p.9.
[61] Ibidem, pp.9-10.
[62] Vincenzio Viviani, *Racconto istorico della vita del Galileo* (Florence: 1718). On this biography see Michael Segre, "Viviani's Life of Galileo", *Isis*, 1989, 80:207-231.
[63] Colangelo praises the opinion of the intransigent cardinal Giacinto Sigismondo Gerdil: "Une grande et nombreouse population n'est pas aussi profittable dans la Republique des lettres, qu'elle l'est dans l'état civil. Mille demi-savans ne font pas un savant, mille penseurs libres ne font pas un philosophe, il s'en faut de beucop que tous les faiseurs de paradoxes soient des genies... Voulez-vous diminuer le nombres des aspirans aux grades, soumettez à des examens severes ceux qui s'y presentent, renvoyez ceux en qui vous ne recoinnoissez pas le dispositions pour profiter dans leurs cours d'etudes" (Gerdil, *Précis d'un cours d'instruction sur l'origine, les droits, et les devoirs de l'autorité souveraine* (1799); in Gerdil *Opere edite e inedite*, vol.7 (Rome: 1807) p.288). Cardinal Gerdil (1718-1802), a theologian from Savoy, in Piedmont, was regarded as one of the most erudite ecclesiastic of his age, and "the oracle of the Holy See" (see *Biographie universel generelle*, sub voce). He was prefect of Propaganda and of the Index, and a member of the Royal Society of London, and published works on scientific and theological matters. Note his *Anti-contract social* (La Haye: 1764); his *Anti-Emile* (Turin: 1763); and his *L'immatérialité de l'âme démontrée contre Locke*, 2 vols. (Turin: 1747-48), which earned him the chair of philosophy in the University of Turin in 1749. He also wrote on continuity in geometry (1741) and on the notion of force in physics (1754). Gerdil's scientific interests are discussed in James Evans, "Fraud and Illusion in the Anti-Newtonian Rear Guard: The Coultaud-Mercier Affair and Berthier's Experiments, 1767-1777", *Isis*, 1996, 87:74-107; pp.99-101.
[64] Colangelo, *Galileo*, p.23.
[65] Ibidem, p.26.
[66] Ibidem, pp.29-30.
[67] Ibidem, p.31.
[68] Ibidem, p.77.
[69] Ibidem, p.78.
[70] Ibidem, p.80.
[71] Ibidem, pp.80-81.
[72] Ibidem, p.93.
[73] Ibidem, p.113.
[74] On Alfonso Borelli see Domenico Bertoloni Meli, "The Neoterics and Political Power in Spanish Italy: Giovanni Alfonso Borelli and his Circle", *History of Science*, 1996, 34:57-89.
[75] Colangelo, *Galileo*, p.115.
[76] Ibidem, p.115.
[77] Gioacchino Ventura, "Elogio di Nicola Fergola", in Ventura, *Elogi funebri* (Genoa: 1852), p.8.
[78] Ibidem, p.9.
[79] Ibidem, p.70.
[80] Ibidem, p.73
[81] Ibidem, p.74.
[82] Ibidem, p.97.
[83] Ibidem, pp.99-100.
[84] Ibidem, p.84
[85] Ibidem, p.90
[86] Ibidem, p.87.
[87] Ibidem, p.87.
[88] The thinker is Chateaubriand, who employed this definition in his *Génie du cristianisme*. The whole speech is based on concepts taken by Chateaubriand, including the important notion of "spiritual science" as opposed to "material science".
[89] Ventura, *Elogio di Nicola Fergola*, P.90.

[90] Ibidem, p.95.
[91] Ibidem, .97.
[92] Ibidem, .113.
[93] Franco Palladino, personal communication, July 1997.
[94] [Fergola], *Prelezioni*.
[95] See, for instance, *Prelezioni*, vol.1, p.298.
[96] See *Prelezioni*, vol.2, p.205; for Amodeo's opinion, see Amodeo, *Vita matematica napoletana*, vol.2, p.348.
[97] Naples, Biblioteca Nazionale: III.C.31-36; XIII.B.52; XVI.A.27; XVIII, 13-20. The contents of these manuscripts are described in Ferraro-Palladino, "Sui manoscritti di Nicola Fergola, 1753-1824", *Bollettino di storia delle scienze matematiche*, 1993, 13:147-197.
[98] Ms.III.C.32, 99r.
[99] Fergola, *Prelezioni*, vol.1, pp.24-25.
[100] Ibidem, pp.26-27.
[101] Ibidem, p.195.
[102] Ibidem, p.337.
[103] Nicola Fergola, *Teorica de' miracoli* (Naples: 1839). Note that this was one of the few texts selected by Flauti to be published posthumously. Flauti reprinted it in 1843 and in 1860. This last (fourth) edition, with a new preface, is unknown to Amodeo and Palladino; a copy is held by the library of the Pontificia Università Gregoriana in Rome.
[104] [Telesio], *Elogio di Nicola Fergola*, p.87.
[105] Colangelo, *L'irreligiosa libertà*; p.399 (the letter was published as an appendix to the book). The letter is reprinted also in [Telesio], *Elogio di Nicola Fergola*, p.88.
[106] Giovanni Flauti quote largely from Leibniz and Johann Bernoulli on the nature of miracles, and the freedom of God to change his own decrees (see preface, pp.6-7).
[107] "Our knowledge of natural matters is slightly superior to absolute ignorance; to us the entire nature is a mystery; how dare we to investigate the mind of God, or to deny some facts just because we cannot understand them, and the way in which the Omnipotent operates?; Shall we argue for the impossibility of miracles just because they exceed our reason? (preface, pp.8-9).
[108] Fergola discusses the definitions of miracle offered by Wolff, Clark, and Spinoza. He particularly attack the latter, whose definition is: "miraculum est vocabulum quo imperita multitudo insolitum quodvis naturae opus designat, aut id cuius caussas [sic] adsequi non potest". "This definition", Fergola remarks, "contains many indecencies". In fact such a definition is attributed to Spinoza by the Cambridge Platonist Ralph Cudworth (1617-1688) in his *The True Intellectual System of the Universe* (London: 1678), of which Fergola knew the Latin translation. However it reflects appropriately the Spinoza's ideas on the nature of miracles, as presented in the sixth chapter of the *Tractatus Theologico-Politicus*, "on miracles". Here, as in many other cases, Fergola showed his appreciation for Cudworth, who was an important source for Fergola's theological writings.
[109] Fergola, *Teorica de' miracoli*, p.48.
[110] On Wolff's system see Mariano Campo, *Christian Wolff e il razionalismo pre-critico*, 2 vols. (Milan, 1939); and Ferdinando Marcolungo, "Wolff e il problema del metodo", *Il cannocchiale*, 1989, 2-3:11-38. On Wolff's remarkable influence on the theories of knowledge of the eighteenth century, see Tore Frängsmyr, "Christian Wolff's mathematical method and its impact on the eighteenth century", *Journal of the History of Ideas*, 1975, 36:653-668.
[111] On the concept of *vis viva* see Hankins, *Science and the Enlightenment*, pp.30-35. On the *vis viva* controversy see also Larry Laudan, "The *vis viva* controversy, a post-mortem", Isis, 1968, 59:131-143; and Carolyn Iltis, "Leibniz and the *vis viva* controversy", *Isis*, 1971, 62:21-35.
[112] On the cultural and political significance of theories of matter and motion in the eighteenth century, see P.Heimann, "Voluntarism and Immanence: Conceptions of Nature in Eighteenth-Century Thought", *Journal of the History of Ideas*, 1978, 39:271-283; and Simon Shaffer, "Natural Philosophy", in G. Rousseau and R. Porter (eds.), *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science* (Cambridge: Cambridge U.P., 1980) pp.55-91.

[113] On the political significance of similar theological and philosophical questions, see Steven Shapin, "Of Gods and Kings: Natural Philosophy and Politics in the Leibniz-Clarke Disputes", *Isis*, 1981, 72:187-215.
[114] Fergola, *Teorica de' miracoli*, p.56.
[115] Ibidem, p.91.
[116] Ibidem, p.108.
[117] Fergola's division between different levels of reality, and the correspondent hierarchy of different kinds of knowledge and methodologies, clearly reflects the Thomistic theory of knowledge. Compare Fergola's threefold structure of knowledge (theology, mathematics, and empirical sciences, corresponding to the faculties of faith, intellect, and sensibility) with Aquinas, *In Librum Boethii de Trinitate*, Quaestio V, Art. 1-4. On Aquinas' theory of knowledge see Anthony Kenny, *Aquinas on Mind* (London: Routledge, 1993). On the features of nineteenth-century Thomism, see Georges van Riet, *L'epistémologie thomiste* (Louvain: 1946).
[118] On the opposition between algebra and geometry in Newton, and the metaphysical superiority of geometrical knowledge, see Loup Verlet, "F=MA and the Newtonian Revolution: An Exit From Religion Through Religion", *History of Science*, 1996, 34:303-346.
[119] From documents held by the Oratorian fathers, it results that the executors were Francesco Malerba, Cristoforo Russo and Carlo Schisani (see Antonio Bellucci, "Il trionfo della fede sulle scienze e sulle virtù attraverso le allegorie decorative del soffitto della biblioteca dei girolamini", *Roma*, 2 July 1927).
[120] Antonio Borrelli, introduction to Domenico Cotugno, *De lo spirito della medicina* (Naples: Procaccini, 1988) p.11.
[121] Domenico Cotugno, *De acqueductibus auris humanae anatomica dissertatio* (Naples: 1761); and Domenico Cotugno, *De ischiade nervosa commentarius* (Naples: 1764). On Cotugno's scientific work see Gugliemo Bilancioni, "Domenico Cotugno" in Aldo Mieli (ed.), *Gli scienziati italiani*, vol.1 (Rome: 1923) pp.164-183; Henry Viets, "Domenico Cotugno: His Description of the Cerebrospinal Fluid", *Bulletin of the History of Medicine*, 1935, 3: 701-738. In order to reconstruct his correspondence see Antonio Borrelli, "Carteggio di Domenico Cotugno", *Nuncius*, 1986, 1:93-101.
[122] See Giovanni Romagnoli, "La scoperta degli acquedotti del Cotugno e le prime reazioni del mondo scientifico", *Pagine di storia della medicina*, 1968, 12:78-88.
[123] Hermann von Helmholtz, *Die Lehre von dem Tonempfindung* (Leipzig: 1863); translated by A.J.Ellis as *On the Sensations of Tone as a Physiological Basis for the Theory of Music* (New York: 1948).
[124] Cotugno, *De lo spirito della medicina*, p.34.
[125] Quoted in Antonio Borrelli, introduzione to Cotugno, *De lo spirito della medicina*, p.14.
[126] On the social dimension of similar "anti-systematic" conceptions of the medical practice see, for instance, David Wolfe, "Sydenham and Locke on the Limits of Anatomy", *Bulletin of the History of Medicine*, 1961, 45:193-200; Andrew Cunningham, "Thomas Sydenham: Epidemics, Experiment and the Good Old Cause", in Roger French and Andrew Wear (eds.), *The Medical Revolution of the Seventeenth Century* (Cambridge: Cambridge U.P., 1989) pp.164-190; and Christopher Lawrence, "Incommunicable Knowledge: Science, Technology and Clinical Art in Britain, 1850-1914", *Journal of Contemporary History*, 1985, 20: 503-520.
[127] Domenico Cotugno, *De animorum ad optimam disciplinam praeparatione* (Naples: 1778).
[128] For a study on the relations between natural theology and brain physiology in the seventeenth century, see William Bynum, "The Anatomical Method, Natural Theology, and the Functions of the Brain", *Isis*, 1973, 64:445-468.
[129] His lectures were published as Giuseppe Saverio Poli, *Lezioni di storia militare*, 3 vols. (Naples: 1777); and *Lezioni di geografia* (Naples: 1781).
[130] See Paolo Nicola Giampaolo, *Elogio del commendatore Giuseppe Saverio Poli* (Naples: 1825) p.10.
[131] Giuseppe Saverio Poli, *Testacea utriusque Siciliae eorumque historia et anatome tabulis eneis illustrata*, 2 vols. (Parma: 1790, 1795).
[132] Giuseppe Saverio Poli, *Elementi di fisica sperimentale* 5 vols (Naples: 1822; orig.ed. 1787).

[133] See Oldrini, *La cultura filosofica napoletana*, p.28.
[134] On the controversy between Galvani and Volta on "animal electricity" see Marcello Pera, *La rana ambigua. La controversia sull'elettricità animale tra Galvani e Volta* (Turin: Einaudi, 1986).
[135] See Poli, *Elementi*, vol.5, p.214.
[136] Ibidem, vol.5, p.435.
[137] Domenico Cotugno, *Lettera al Vivenzio sulla elettricità del sorcio* (Naples: 1784), reprinted in Domenico Cotugno, *Opere*, edited by Antonio Iurilli (Manduria: Lacaita, 1986) pp.309-310.
[138] See Poli, *Elementi*, p.316.
[139] See, for instance, the *Dictionary of Scientific Biographies*, sub voce; and *Enciclopedia Italiana*, sub voce.
[140] Giampaolo, *Elogio di Poli*, p.8.
[141] We are told that Poli was close to the Dominican theologian Antonio Valsecchi (1708-1791); see Giampaolo, *Elogio di Poli*, pp.9-10.
[142] Giampaolo, *Elogio di Poli*, pp.25-28.
[143] Giuseppe Saverio Poli, *Viaggio celeste. Poema astronomico* (Naples: 1805) p.xv. The book was published by the Royal Printing Office.
[144] Ibidem, pp.xxviii-xxxi.
[145] Ibidem, p.xxvii.
[146] Ibidem, p.5.
[147] Giampaolo, *Elogio di Poli*, p.45.
[148] Serafino Gatti, *Elogio del cavaliere Giuseppe Saverio Poli* (Naples: 1825) p.19.
[149] Gatti, *Elogio di Poli*, p.39.
[150] Ibidem, p.40
[151] In appendix to the anonymous *Iosephii Xaverii Poli Elogium* (Naples: 1825), from the Royal Printing Office.
[152] See Zazo, "L'ultimo periodo borbonico", p.471.
[153] See [Telesio], *Elogio di Fergola*, p.149.
[154] Quoted in Zazo, *L'istruzione pubblica e privata*, p.76.
[155] Poli, *Elementi*, p.xiv-xv.
[156] Ibidem, p.xvi.
[157] Gatti, *Elogio di Poli*, p.19.
[158] Giampaolo, *Elogio di Poli*, p.15.
[159] Poli, *Elementi*, pp.18-19.
[160] Ibidem, p.68.
[161] Ibidem, p.90.
[162] Ibidem, .167.
[163] Ibidem, p.228.
[164] See, ibidem, pp.2-5.
[165] Ibidem, p.8.
[166] Ibidem, p.7.
[167] Ibidem, p.437.
[168] Ibidem, pp.437-438.
[169] The social and cultural meaning of similar controversies between mathematical and non-mathematical conceptions of empirical reality has been pointed out. See, for instance, the debate over early modern astronomy, as described in Robert Westman, "The Astronomer's Role in the Sixteenth Century: A Preliminary Study", *History of Science*, 1980, 18:105-147; Nicholas Jardine, *The Birth of History and Philosophy of Science. Kepler's "A Defense of Tycho against Ursus", with Essays on its Provenance and Significance* (Cambridge: Cambridge U.P., 1984); and James Lattis, *Between Copernicus and Galileo: Christoph Clavius and the Collapse of Ptolemaic Cosmology* (Chicago: Chicago U.P., 1994) particularly chapter two on Jesuit mathematics. On the same topic see also Nicholas Jardine, "Epistemology of the Sciences", in Charles Schmitt and Quentin Skinner (eds.), *The Cambridge History of Renaissance Philosophy* (Cambridge: Cambridge U.P., 1988). Of great interest is the related seventeenth century controversy known as *quaestio de certitudine mathematicarum*, on which see Paolo Mancosu, *Philosophy of Mathematics and Mathematical Practice in the Seventeenth Century* (Oxford: Oxford

U.P., 1996) chapter one (which is not particularly enlightening about the social dimension of the debate).

[170] Giuseppe Saverio Poli, *Breve ragionamento intorno all'eccellenza dello studio della natura, ed a' sodi vantaggi che se ne possono ritrarre* (Naples: 1780); and Giuseppe Saveri Poli, *Ragionamento intorno allo studio della natura* (Naples: 1781).

[171] Poli, *Breve ragionamento*, p.vi.

[172] Ibidem, p.xix.

[173] Poli, *Ragionamento intorno allo studio della natura*, p.32.

[174] Giampaolo, *Elogio di Poli*, p.15.

Chapter Six

The Synthetic School, or Mathematics as Contemplation of Truth

Fergola began explicitly to refer to the need for re-discovering pure Greek geometry in a memoir read at the RAS in 1786. It was the first public presentation of his "Euclidean program", which concerned not only geometry but any other branch of mathematics. As we have seen, the expansion of the "empire of analysis" had been contrasted since the 1770s by scientists such as Cotugno and Poli, who questioned its being a reliable cognitive instrument in the natural and moral sciences. Fergola effectively contrasted the penetration of the "analytic spirit" in pure mathematics as well; and to this extent he provided an alternative —geometrical— foundation for mathematics. This foundational theory legitimized his boundary-drawing strategy regarding the possibility of applying mathematics to the empirical world. Indeed, historians Chasles and Carnot recognized the priority of Fergola's school in the restitution to pure geometry of its "dignity", through the rediscovery of "Greek purity" —a program which was to become important in France and Germany during the 1820s. In this last part of the present study, we shall go back to the original mathematical controversy from which we started, providing a more complete presentation of its causes, its dynamics, and its eventual closure.

6.1 Nicola Fergola and the Geometrical Turn of Neapolitan Mathematics

Fergola's life is presented by his biographers, as an exemplary one[1]. Born into a middle-class family in 1753 —his father was a bureaucrat— Fergola studied Greek and Latin literature at a Jesuit college until the expulsion of the Society from the Kingdom (1767). In college, he was trained in fencing, music and singing, and —we are told— he excelled in each of them. Then something similar to a conversion happened, which put an end to his "worthless days" and to his "religious indifference" (note the analogy with Canosa's autobiographical notes)[2]. From then onwards, the only interests of the young man were to be religion and science; in fact his pupils and admirers claimed that Fergola had restored mathematics in Naples after decades of decline. In particular, Fergola was remembered for restoring the pure and elegant way in which mathematics was practiced by the ancients. "Purity" seems to be the main feature of both his religious faith and his mathematical work. If his life was characterized by an "angelic, heavenly purity"[3], an almost non-human purity was also attributed to his synthetic geometrical methods. The models for his purity were in the past. In religion, it was the simple faith of early Christianity and the pure doctrine of the patristic literature, that is to say the spirit of "the golden age of religion"[4]. In mathematics it was the purely synthetic method of the Greek geometers and its developments due to Christian mathematicians of the seventeenth century, that is to say, the highest achievement of the human intellect. Both these choices were far from obvious to a Neapolitan mathematician of the 1780s.

After the expulsion of the Jesuits and the closure of their colleges, Fergola studied mathematics with Giuseppe Marzucco and Marcello Cecere at the College of the Saviour, a new royal college of higher education which replaced the Jesuit *Collegio Massimo*. We are told that Fergola experienced in this way the low level of mathematical teaching which was provided by colleges at that time (Fergola's biographers did not mention that Marzucco had published a piece of work containing applications of integral and differential calculus). Apparently, Fergola was deeply touched by the exposition of a Euclidean theorem by Marcello Cecere, professor of Synthetic Mathematics. The episode is presented by his pupil Telesio, an Oratorian priest, as a sort of mystical illumination: "the light of the geometrical truths hit the young man [...], and he suddenly saw the art, the art by which the great Geometer [Euclid] received his *Elements*, and so he grasped the high principles of geometrical invention"[5]. Apart from this highly symbolic episode, biographers remark that Fergola's education in higher mathematics was mostly self-taught. But following biographers too closely on this point could be misleading, as their goal is obviously that of highlighting the uniqueness of the figure of Fergola, and his radical break with the previous tradition. In fact Fergola's philosophical and

NICOLAUS FERGOLA

Scrutari Veteres Felix Felicior Idem
Ante Novos Omnes Ire Mathematicos.
Nicolaus Ciampittius Equ.^es et Canon. Cecinit.

scientific education was a rather standard one. For a start, he frequented the palaces of the "enlightened" philo-French aristocracy of the 1770s. In particular, he could access the private library of Domenico Berio Marquis of Salza, as he tutored his son Francesco; the library was unique in Naples, as it was rich in modern scientific texts and it contained collections of the acts of many European academies[6]. Moreover Fergola had been taught at the private studio of Vito Caravelli where, as we have seen, good mathematical education was provided, including integral and differential calculus[7].

While privately studying mathematics, Fergola completed his university studies of law and metaphysics, to which he had been originally addressed by the family. In his studies of law, Fergola had as a guide Giuseppe Cirillo (professor of Roman Law), while in metaphysics, we are told that Fergola studied deeply the works of Ralph Cudworth (1617-1688), Christian Wolff, and the early Genovesi, whom he greatly admired. In mathematics, Fergola studied Newton, the Bernoullis, Euler, Brook Taylor (1685-1731), and many other "geometers and analysts, considered equally as solemn teachers"[8]. Telesio provide us with a list of mathematical textbooks available to the young Fergola and, apart from the works by the brothers di Martino, Telesio remarked that they were extremely unsatisfactory[9]: around the young Fergola Telesio saw only "the desert".

If we now go back to the information we have collected about the training of the "Jacobin mathematicians", we see that most of them had originally been trained in law at the RUN; and that most of them had studied mathematics with Vito Caravelli either at the Military Academy or privately. In fact, the young Fergola knew and appreciated men like abbé Pacifico and he entered the RAS in 1779 thanks to the support of Caravelli, precisely as Filippis did in the same year. A critical reading of the biographies simply reinforce the impression that Fergola went through a normal scientific education, which included differential and integral calculus, and their application to mechanics.

In the late 1770s Fergola began to teach mathematics privately; in 1779 he began lecturing on philosophy at the College of the Savior. In the same year he read a paper at the RAS; it seems that in this piece of work —which is currently lost— Fergola presented and solved two geometrical problems through the application of integral calculus[10]. Interestingly, in 1779 Fergola also edited a textbook based on

Genovesi's lectures on experimental physics, to be used as textbook at the College of the Savior[11]. The book was dedicated to Domenico Berio the owner of the library where Fergola had been studying for years. In his preface Fergola praised, in the style of Genovesi, the utility of the study of physics for agriculture, medicine and for many other activities of everyday life. He also suggested that the observation of physical nature provide the foundation for morals[12]. Nevertheless, Fergola's reading of Genovesi is already different from that of the reformers, as he stressed the link between physics and theology ("nulli rei tam est necessaria Physica quam Theologiae studium"); he supported a teleological and providential vision of the physical universe[13]; and he provided an account of the history of physics which reminds one closely of the doctrine of the *philosophia perennis*, linking in one single scientific tradition the Greeks and Wolff[14]. Through his particular reading of Genovesi, Fergola was placing himself in the tradition of the post-Wolffian rationalistic philosophy which had always been present at the RUN and which was to be suddenly revived in the 1790s by reactionary authors. The studies of law, in particular, were embedded in this sort of metaphysics, and this was the critical target of the reformers like Filangieri and Pagano, who had learned a very different lesson from Genovesi: that of the battle against metaphysics, of the "civil philosophy", and of the need for administrative and economic reforms. Although moving from the same maestro, Fergola and the reformers were in fact taking opposite indications out of his complex work. That metaphysical-theological system which proved old-fashioned and unbearable to the young aristocrat Filangieri and to the provincial landowner Filippis, was regarded as highly promising by the young teacher of mathematics Fergola. His inclination for metaphysics and his intransigent Catholicity are already clear in 1779. How did they affect his work as a mathematician? The question is rather interesting, as there is no evidence that Fergola had a different training in mathematics with respect to his fellows who later would incline for analysis —and for revolution. And indeed his first productions can be seen as part of that interest in the calculus by which we have previously characterized the reformist decade of the 1780s.

In 1780 Fergola read a second paper at the RAS, about certain optical problems[15]. Again integral and differential calculus were employed, this time to make sense of certain physical phenomena. In a third memoir, read in 1783 Fergola provided a solution for the problem of calculating the areas of certain spiral surfaces (*volte a spira*), which was directly related to important architectural applications[16]. The RAS had asked for a solution of this problem, as the "traditional method" for squaring spiral surfaces used by architects was suspect. In his work Fergola showed how "to quadrate, with the aid of geometry and calculus" this kind of surfaces; and he also provided a generalization for his solution. He proved that the traditional —purely geometrical— method was faulty as it was based on erroneous assumptions, and that integral calculus was indeed needed. But in the same paper Fergola praised a professor from the University of Salerno for having provided a purely geometrical proof for a certain theorem he had previously solved with integral calculus, and he saw this result as "confirming" his calculations[17].

The first work in which Fergola openly declared that he wanted to rescue ancient geometrical methods from obscurity is dated 1786[18]. It was another memoir presented to the RAS, and it consisted of a series of geometrical problems solved with "a new method". Fergola praised the introduction of analysis into geometry carried out by Descartes; this new "heuristic art" had been indeed the source of great progress in problem-solving during the eighteenth century. But, he noted, it is despicable that the purely geometrical methods of the ancients have been completely neglected, so that "now they are uncultivated and derelict"[19]. On the basis of what has previously been shown in this study, we can argue that Fergola was perfectly consistent in his claims, as what he praised was a use of analysis which could be (in principle) reduced to pure geometrical reasoning. His worries about analysis were foundational ones, the only possible foundation being to his eyes pure geometry. So he could easily agree that the introduction of analytic methods in geometry yielded a rich new *heuristic* method; but he could not refrain from criticizing those analysts who —embracing the spirit of analysis— thought that analysis was a legitimate way of reasoning *on its own*, and that pure geometry was a mere relic of the past, good at most for primary schools. To balance what he saw as a dangerous "diversion from geometry", in his 1786 memoir Fergola showed how a series of problems "of site and position" could be easily solved through the use of a purely geometrical method of reduction (of one problem into another equivalent problem) which Fergola called the "principle of conversion". Fergola looked for a high level of generality in his claims, and he showed that all problems of "site and position" can be grouped in three main classes, providing a specific problem-solving method for each one of them. This quest for the higher generality of problem-solving methods was typical of Fergola's productions, possibly because this was the only way in which he thought synthetic methods could eventually return to the center of geometrical practice.

Anyway, in three years his interest had moved from the practical applications of integral calculus to the geometrical solution of a family of problems which had no interest but for historical reasons (and, by the way, which were considered as the most difficult to be solved through pure analysis). Fergola's 1786 memoir was followed by the memoir of a student of his private school, Annibale Giordano, aged seventeen. Giordano was the son of a physician who was employed by the court in Naples, and by the family of the Prince d'Ottaviano, to which the statesman Luigi de' Medici belonged[20]. Extremely precocious in his studies of Latin, Greek and history, he was brought by his father to Naples around 1783, to study mathematics with Fergola. In his memoir Giordano applied Fergola's "principle of conversion" to a number of "problems of site". Through the principle, the problems were transformed in more treatable ones, "their nature remaining the same"; then Giordano solved them "with the geometrical analysis of the ancients". Another series of problems was presented by Fergola in 1787; he remarked that his method had proved to be extremely useful, and that it was based on the truth of certain lemmas discovered by "meditating on the nature of the geometrical problem" – truths which "would hardly appear in the network of an analytic calculus, no matter how well executed it is"[21]. Fergola also informed the RAS of the brilliant solution provided by Giordano to the well-known "problem of Cramer". Solutions for this plane geometry problem had been previously provided by Cramer, Castillon, Euler, Lagrange, Lexell, and Fuss. Fergola had directed Giordano to Pappus' collection in order to find some lemma that could facilitate the solution of the problem, and make it more elegant. In fact, Giordano provided a purely geometric solution which was considered, by the cultivators of synthesis, much more elegant than Castillon's one. The solution was inserted by Antonio Maria Lorgna in the acts of the Italian Academy (or *Società dei XL*)[22], and it was later cited by Michel Chasles[23] and Lazare Carnot[24] as a good example of pure Greek-like synthesis. A revised version of the memoir was re-edited to open the collection of works by members of Fergola's school published in 1811[25].

In 1786, the popularity of his school growing thanks to the *enfant prodige* Giordano, Fergola applied for a place of "pensioner" at the RAS. In his application Fergola presented himself as the one "who, first among the Neapolitan mathematicians applied the integral calculus, so sublime in being managed, to the Science of Nature"[26]. He was refused the place, which went to an unremarkable lecturer of mathematics at the Military Academy[27]. Indeed, it seems that during the 1780s Fergola's school did not enjoy the favor of the reformist intelligentsia, nor did it attract the interest of civil authorities. Instead, Fergola's geometrical approach to mathematics had to face criticisms, as it looked old-fashioned and inadequate to those inclined to follow "the spirit of analysis". A couple of specific episodes testifies to these criticisms. We said Fergola presented a memoir on optics at the RAS, in 1780. Biographers agree that the memoir was openly criticized by an eminent figure, a *Cavaliere*, who maintained that such difficult questions should be treated with the purely analytic methods of the French mathematicians[28]. This *Cavaliere*, who "depreciated the Neapolitan name", "had been living in Turin, London and Paris, and here he had frequented d'Alembert, Diderot, Condorcet, and Voltaire". Which unmistakably lead us to Marquis Domenico Caracciolo[29], a protagonist of the reformist period. We saw that the former ambassador and future Prime Minister Caracciolo had invited Lagrange to join the Academy in 1781, and now we see that he was also explicitly critical of Fergola's methods. Caracciolo, a former pupil of Genovesi, was a skeptical and anti-ecclesiastic thinker, who thought that "a well organized state" should keep religion detached from education. His political action had been devoted to free the Kingdom of Naples from any link with Rome and to fight the jurisdiction and the political power of the feudal aristocracy. Furthermore, in line with the reformist plans, he supported the construction of new roads, the increment and liberalization of trade, and the preparation of a modern land register. Back from Paris in 1780, he found that Naples was on the wrong track in its scientific and mathematical development. Significantly, when he died in 1789, he was planning a radical reform of the university, on the model of the University of Pisa.[30] A second episode is related to the Neapolitan sojourn of some French officers lead by General François Pommereul, to support the reform of the artillery of the Bourbon army (1787). Some of them decided to attend the lectures at Fergola's school, to assess the preparation of the students. Telesio tell us that the French presented some geometrical problems for solution (called "taction problems", or "problems of contacts", as they treat the relations between certain given straight lines and certain given circles). Annibale Giordano, Stefano Forte and Felice Giannattasio three of the oldest and brightest students, solved the problems "with classical elegance" to the pleased surprise of the French, who asked for some copies of Fergola's lectures[31].

1789 was an important year in our story. As the intellectual atmosphere began to change, a redistribution of chairs took place at the College of the Savior. Fergola left philosophy and was appointed to his first mathematical chair: Analytic Mathematics and Mathematical Physics, with a remarkably improved wage (240 ducats against 36). A new season began for Fergola's school of mathematics, now firmly entrenched into an official institution of higher education. The letter of appointment, dated 2 November 1789 began like this:

> The King, being persuaded that the virtues and the good behavior of his subjects is made natural through teaching, prepared a new plan for the education of the young studying at the College of the Savior; so that the Neapolitan nation could be improved both in its customes and in its spiritual knowledge.

Now, "considering his deep works and his reputation in the field", Fergola was given the chair[32]. In the same year, Fergola was also successful in obtaining for his favorite pupil Giordano a chair of mathematics at the Military Academy. Another young chemist and mathematician had applied for the post, but was excluded from the competition: his name was Carlo Lauberg. Behind Lauberg's exclusion was a manoeuvre of the now influential Fergola, who later wrote: "when I proposed to our Military Academy D. Annibale Giordano, I let France and Northern Italy knowing that a great geometer was teaching among us. And, by excluding him from the competition, I freed the Academy from D. C. L. [Don Carlo Lauberg], great villainous". Amodeo and Croce explained Fergola's hate for Lauberg by referring to his being an unfrocked and married priest; but this is incorrect if one refer to 1789, as at that time Lauberg was still a scolopian priest[33]. Also in 1789, Giordano became external examiner at the Naval Academy, and entered the RAS as resident member.

In 1791 Fergola published his lectures on conic sections[34]. Telesio said his maestro judged the textbook on conics available at the time inadequate; so, for instance, Fergola thought that de La Hire, in his synthetic textbook, used too many "external" (i.e. non-geometrical) devices, including "tortuous" pieces of algebraic analysis and truths from mechanics or optics[35]. The book was put together by Fergola with the contribution of Felice Giannattasio, who prepared an historical introduction to the topic —which included the last developments of the eighteenth century, with Simpson, Euler, de l'Hopital and Cramer— and made the drawings. The presentation of the geometrical properties of the three curves is clearly inspired by Apollonius, and it is accomplished with "Euclidean rigor". This work was to remain the textbook of Fergola's school for decades, and it was used in colleges all over the kingdom. Fergola also published the textbook *Analytic Treatise of Conic Sections* (1814), where he showed the principal properties of the curves by means of Cartesian analysis, "so that the young, while learning these truths, get used to reason correctly and elegantly with both Methods; and one also learns how to convert properly the one into the other"[36]. Finally, he published the *Analytic Treatise of Geometrical Loci* (1818), dealing with the famous problem of the four straight lines as it was formulated by Pappus[37]. These last two textbooks are most representative of that sort of Cartesian analysis favored by Fergola. If Apollonius was the model for the pure geometrical methods, Descartes was the guide when it came to the "proper analytic method", which, as we have seen, was a mixed method where pure geometrical reasoning is partially replaced by algebraic calculations —made *via* the choice of specific and opportune systems of coordinates— provided that the results of such calculations are immediately re-transformed in geometrical terms through the use of specific techniques such as the "construction of equations". The 1814 treatise —remarkable for its methodological uniformity—is clearly designed to show the superiority of the Cartesian method over the purely algebraic one. The criticisms against pure algebraic method found their extreme expression in Flauti's introductory note to the second edition of the treatise (1828). As for the topic of the 1818 treatise, it had been chosen by Descartes himself to prove the power of his new methods. Fergola presented interesting results in Cartesian geometry: a solution for the problem of finding which position two systems of coordinates should take so that certain specific relations hold between the two couples of coordinates of the same point on the curve; and a (typically Fergolian) method to draw a "geometrical locus" when its equation is known; some considerations about solving problems of third and fourth degree by reducing them to the search of those points which are common to two conics. Finally, other technical aspects of the graphic solution for solid and hypersolid problems were considered.

Fergola's course on conics was followed, in the curriculum, by his lectures on the "heuristic art", the general method for discovering geometrical truths. The lectures about heuristic art remained in manuscript until 1842, when Flauti published part of them in response to Padula's critical remarks[38]. Among the central issues of this piece of work are the nature of geometrical problems, the connections between data and solutions, the "geometrical analysis" of the Greeks, and the Cartesian method. The main goal is to reconstruct the allegedly lost heuristic methods of the Greeks, i.e. the canons of their geometrical analysis. Let us remember that the steps were: 1-supposition of the fact; 2-consequences; 3-reduction of the problem to another problem whose solution is known; 4-geometrical composition, which includes construction and final proof. Let us also remember that if the first three steps are replaced by algebraic analysis, the fourth step must be taken by a conversion of the algebraic expressions to geometrical magnitudes, and of equations to geometrical proportions, as only after the construction and proof can a problem be considered as solved. Also note that "a proof is said to be elegant if it makes us accept a proposed truth through easy and clear ways", and that "geometrical wisdom is to prove with the greatest elegance the proposed truths". In these lectures Fergola also codified those new techniques he and Giordano had refined to improve the efficacy of pure geometrical analysis (as in their "synthetic" memoirs of 1786 and 1787). Fergola called them the "principle of conversion" and the "transfer principle", and their main function was to reduce geometrical problems to a few basic "types" which could be solved through the application of the same method.

In 1792, as the first volume of his mechanics was published, Fergola was offered a vacant chair of mechanics at the Military Academy. Again, the king asked for Fergola to be offered the place[39]; but Fergola —already charged with a number of official duties and still running his private school — had to decline. The 1790s saw Fergola's school grow in popularity and prestige; in these "happy days"[40] students arrived in number from the provinces to study with the maestro, and in fact every noteworthy mathematician of the following generation had some training at the school. They were "brilliant years for the mathematical sciences" wrote Telesio[41], who remembers, among the disciples, Luigi de Ruggiero —later professor of mechanics at the university— Ippolito Berarducci, Nicola Adami, and the statesman Nicola Intonti, Secretary of State and Minister of Police. One must conclude that the cultural reaction that ravaged the capital since 1796, the arrests and the books burning we described earlier, spared Fergola and his pupils. Instead, they clearly enjoyed the favor of the Crown and of the now influential ecclesiastic authorities.

A remarkable episode shook the school in its early days though. Annibale Giordano, Fergola's most brilliant pupil during the period 1783-1790, eventually decided to abandon his maestro's way. In 1789 Giordano had entered the Military Academy as lecturer in mathematics, and here he met Carlo Lauberg, temporary lecturer of chemistry. Around 1790 Giordano was still in touch with Fergola, as he revised an early version of the textbook on mechanics, published in 1792; but at the same time he joined Lauberg's private school as a teaching-assistant. Giordano was 21 and Lauberg 27 when they began giving regular lectures in mathematics and chemistry at Lauberg's house, in Vico dei Giganti. In 1792 they opened the famous private studio of chemistry and mathematics in Piazza Santa Caterina, and by that time it seems that Giordano was no longer collaborating with his old school. In his work the elegant Greek-like solution of ancient geometrical problems had been replaced by a more ambitious scientific (and political) program: the universal application of analytical thinking to reality. Interestingly Telesio wrote a short essay in order to attack a couple of Giordano's apologetic biographies published in France in 1836, the year of his death. He ridiculed the passages where the Jacobin mathematicians were portrayed as restorers of science in a country where "truth and science were suspect and persecuted", and a despotic government aimed "to put thoughts in chains"[42]. Telesio concluded: "as everyone can understand, Naples suffered a great misadventure, as young men of high ingenuity did not trust and follow with docility the voices of the wisest persons". Anyway, "with regard to Fergola's school" the "loss" of Giordano was "more than compensated" by the doctrine and behavior of the other pupils, men such as Giuseppe Scorza and Vincenzo Flauti —who was rich in "talent, and not only for mathematics"— for whom "the government had always the highest esteem"[43]. About the mathematical practice of Fergola's pupils, since the late 1790s it was more and more concentrated on pure, Greek-like geometry. Fergola's "Euclidean program" in analysis was not pursued by his students, in spite of his teaching higher mathematics until 1812. The same quest for generality, typical of Fergola's earlier geometrical works, was lost in the following research, as his students concentrated precisely on very specific problems, whose significance was mainly historical. Nevertheless, this is not to say that the pupils misunderstood and distorted their maestro; as I tried to show, Fergola's research program was *already* fundamentally opposed to the analytic one. Fergola's pupils radicalized the geometrical perspective, and they manifested an unprecedented hate for the practice of analysis (we saw Flauti's judgments on analysis when replying to Padula; another example is Telesio, who compared purely analytic geometry to a "curse"[44]).

The 1799 revolution had important consequences for the institutionalization of the school. Contrarily to many other men and women of science, Fergola and his pupils remained extraneous to the republican experience. "The noble school was gloriously advancing on his path" remarked Telesio, "when the devastating storm which rose in Paris in 1789 finally reached Naples in 1799"[45]. Fergola continued his lectures at the College of the Savior until it was closed down and transformed in a military hospital. Then he retired to a country house on the hill of Capodimonte, a "solitary and sunny place", far from "the noise of the town"[46]. In November 1799 the restored government re-opened the university, which had been sacked and close down by Cardinal Ruffo's Holy Faith Army. New professors had been "opportunely chosen" by the king himself[47]. In fact, eighteen professors were missing, seven being killed defending the republic and eleven arrested. The Reactionary Catholic monsignor Agostino Gervasio, Major Chaplain, was nominated *Prefetto dei Regi Studi*, i.e. principal of the university, in charge for controlling the contents of the lectures. The chair of Economy and Trade (which was of Genovesi, and later of the Jacobin Troiano Odazi) and that of Feudal Law were given to members of the government. The plan of the Crown was that of "promoting true and sound knowledge", and "extirpating the dangerous doctrines which have caused so much ruin and destruction", by means of "the promotion of true culture and by avoiding the moral corruption of the young"[48]. Monsignor Gervasio proposed a project of reform for public education, as he considered the university "very much infected". The proposal was violently repressive –it included the abolition of many university chairs and of primary and secondary schools, so that young students were to immediately enter the schools annexed to religious seminars. This and other similar projects were discussed until Cotugno and Poli were finally asked to prepare a specific project of reform for the university (1805)[49]. What was most needed were "reliable" professors. Early in 1800 Marzucco died, leaving a crucial chair of mathematics vacant (Sublime Mathematics, i.e. higher mathematics). The choice was straightforward: in March 1800 a royal dispatch was sent to Fergola, portrayed by Telesio as still immersed in his "high speculations" in Capodimonte. The dispatch began like this:

> The King, having been informed of the excellent capacities and solid knowledge of V.S. [your person], and of your conserving a loyal attachment to the R[oyal] Crown, decided to nominate you professor for the chair of Sublime Mathematics... [50]

Fergola accepted the professorship, but he went rarely to town, preferring to work in his quiet house at Capodimonte; a substitute, appointed by monsignor Gervasio, often gave lectures in his place[51]. In fact, Fergola was working on the metaphysical and theological aspects of his mathematical work. For Fergola, as for other Reactionary Catholic authors, the post-revolutionary years were devoted to a deep reflection about the role of religion in the general structure of knowledge and in the defense of traditional society (think of Colangelo's 1804 book on religion and the sciences, or of Canosa's political-religious works of 1804-05). The result was the essay on miracles, that on Saint January and the aphorisms on philosophy and theology, most of which were published by Flauti in 1839. In 1804, Fergola exchanged letters with Colangelo; the erudite Librarian of the Oratory asked the mathematician to provide a mathematical argument to support the existence of God, to contribute to the great battle against atheism and rebellion. Fergola, as we have seen, replied with enthusiasm. Also in 1804, Fergola was invited by the Pontiff Pius VII to enter the Academy of Catholic Religion, specifically established in 1801 to fight the secularization of knowledge[52]. By that time, Fergola's fervent faith and his ascetic style of living had become proverbial in Naples; his biographers reported a number of anecdotes which underline his religious virtues. We are told that he was on a strictly vegetarian diet; that he walked, every Saturday, from

Capodimonte to a very far sanctuary, dedicated to the Holy Virgin, for whom he had a particular devotion; that he took part in popular processions, often inflicting on himself supplementary punishments, such as cilice and chains; that he didn't hesitate to mix with the most humble people to listen to predicants; that he never entered the Royal Gallery of Art, because of the nudity of the statues. Finally, that he practiced life-long chastity[53]. In fact, every theological and moral virtue is represented in such anecdotes on Fergola. It is also clear that he practiced with intensity all those forms of external devotion which were recommended by the counter-revolutionary "missions" of the early nineteenth century.

Meanwhile, Fergola being out of town, his students Giannattasio and Flauti had taken over his private studio (which is what they called most properly "our school"). In addition, appointments began to be generously offered to Fergola's young students. In 1802, Giuseppe de Sangro[54], aged 27, was appointed to a chair at the newly established Military School, which replaced the Military Academy whose members had been deeply involved in the revolutionary events. In 1803 Felice Giannattasio was also called to the Military School, to take the chair of Sublime Mathematics. In the same year Vincenzo Flauti, aged 21, was appointed the newly established chair of Synthetic Mathematics at the university; the royal dispatch read: "H.M. the King wanted to give an example, rewarding in this young man both knowledge and perfect morality"[55]. After 1800, members of Fergola's school were in fact charged with controlling mathematical teaching and research in the RUN and in the Military School, i.e. the most prestigious institutes of higher education. Theirs could now be properly called the "Neapolitan school of geometry".

6.2 A Collection of Synthetic Works (1811)

Most representative of the productions of the school in the early nineteenth century was the collection of memoirs edited by Flauti and Giannattasio in 1811 under the title *Mathematical Pamphlets of Fergola's School*[56]. The publication had a clear didactic function; it should also be "a model" for the future publications of the RAS. Once again, the superiority of Cartesian analysis was claimed over Lagrangian analysis, and the use of graphic methods in problem-solving was highly recommended. The memoirs were introduced by a preface by the editors (possibly Flauti and

Giannattasio), where "the real goal of mathematical disciplines" was individuated in "guiding the spirit in the sublime art of inventing, which proves the celestial origin of human reason"[57]. Only when human spirit reaches this "maturity", can it to continue on the path of the ancient geometer-inventors, which is the way of geometrical analysis. The young Neapolitan geometers proudly linked their practice to those pre-Platonic geometers of the Pythagorean school who were active in Southern Italy in the fourth century BC. It was for "national glory" that they were taking on —after a long period of oblivion—this original tradition in the art of inventing, the heuristic art, rediscovered by Fergola. At the same time the pamphlets replied to those who said that Fergola ignored the developments of analysis: he "has promoted the study of modern analysis", and he knew "the secret of informing analysis with the spirit of synthesis, without altering its nature; so that he presented the theories [of analysis] with the method and the demonstrative rigor proper to the geometrical writings of Euclid and Apollonius"[58]. The collection was opened by a revised and generalized version of the synthetic solution provided by Giordano for Cramer's problem. This paradigmatic solution had succeeded where "algebraic analysis was impotent"[59]; Giordano aimed indeed to show, very straightforwardly, "how, in many cases, synthesis overcomes analysis", which is actually done by opposing his elegant solution —obtained through the application of a lemma by Pappus— to the "complex" analytic solution provided by Lagrange. The target are those who presently "depreciate geometry" (ignoring that it is in fact "the common mother [of geometrical and algebraic analysis]") and those who only cultivate the methods of modern analysis, without caring about properly geometrizing". Only by granting equal dignity to the "two wings" (i.e. the two methods) can mathematicians obtain important results in pure mathematics and in their application to nature[60]. In Giordano's solution the editors found the print of the "Greek genius"[61]; Castillon's solution is said to be "heavier and less elegant" as more lemmas and more constructions were required[62]; Lagrange's solution, in spite of containing "certain sublime analytic flights", ended up in equations whose construction proved extremely difficult: but "this was a shortcoming of the [analytic] art, not of the great man"[63]. Note that (purely algebraic) analytic reasoning is compared with a spectacular flight, as opposed to the slow but safe proceeding of geometrical reasoning; groundless rapidity versus sound, certain progression; imagination versus truth.

A different solution for a generalized version of Cramer's problem is presented in a memoir by Giuseppe Scorza. He used a Euclidean porism "discovered" by the Scottish geometers Robert Simpson and Matthew Stewart —"who emulated the Greek accuracy"— in order to solve "an entire family of difficult problems". The editors warned the reader not to be mislead by the simplicity of Giordano's and Scorza's synthetic solutions —i.e. not to mistake the clarity of their reasoning with the facility of their discovery. The art of inventing is in fact the most difficult achievement of the human intellect[64].

Other famous geometrical problems were treated in the collection. Stefano Forte provided a synthetic solution for "the problem of Wallis' cylindroid", i.e. a problem concerning the properties of the solid obtained by the rotation of a hyperbola around its secondary axes[65]. The problem of the cylindroid can be derived from Archimede's treatment of conoids and spheroids, and it was studied by Wallis and by Antoine Parent (1666-1716); d'Alembert had asked the readers of the *Encyclopédie* to solve a version of this problem. The problem had been solved with analysis: the Barnabite father Gregorio Fontana (1735-1803), well-known mathematician from the University of Pavia, solved it by means of differential and integral calculus[66]. Forte sketched Fontana's procedure, then he solved it through algebra and geometrical analysis (he did not miss the opportunity to remember that "Greek culture has been entirely transmitted through hereditary succession" to present-day Italian geometers[67]). The same problem is then solved with Cartesian analysis by Giannattasio, and synthetically by Flauti, who used certain theorems by Viviani ("the Italian Apollonious") and achieved the construction of an analytic solution for the same problem. Eight years later, in 1819, a new geometrical solution was to be published by Giuseppe Sangro in the Acts of the RAS, together with Fergola's own contribution, which consisted in a solution to a more general version of the problem. This problem appeared a last time in a 1839 memoir by Flauti, where he synthetically proved a series of propositions about the quadrature of the cylindroid originally found in Bonaventura Cavalieri.

Excerpts treating the problems "of the inclinations" from Fergola's unpublished *Heuristic Art* were also inserted. A series of problems was solved through the geometrical method of the "loci", which consists in the following steps: 1) the solution of the problem is reduced to the determination of a single point; 2) eliminating one condition for this point, in order to determine the locus of the infinite number of positions it can consequently assume; 3) to determine one intersection between two such loci. In this way a number of different solid and hypersolid problems could be reduced to that of determining the intersections between certain circles and certain straight lines. For certain families of problems this was in fact the most commendable method of solution, as analysis would provide "impracticable and horrible results"[68]. "Two coordinate analysis, which certain modern analysts are so proud of" is nothing but the "Cartesian method freed from synthesis", so that "data and questions of a geometrical problem" reduce to analytic values, "manipulated" under certain conditions to reach the final equation. This can be sometimes "useful", but in the specific case of the problems "of site" it does not help the geometer, as synthesis is the only "light of the sites"[69]. One of the problems, wrote Fergola, "is particularly famous among us, because it consolidated the superiority of our methods with respect to those of the two co-ordinate analytic geometry"[70]. Fergola referred to an episode which happened in 1807, when "a professor from Northern Italy" visited Naples and criticized the "Greek geometrizing" of the school. Scorza proposed then a very simple problem for the "stranger" to solve: the result was a complex analytic solution, valid only for certain cases; at this point Scorza could proudly present his own solution, "executed with few passages of synthesis, in our own way" [71]. Fergola presented the synthetic, purely analytic and Cartesian solutions, "to clearly see which method is most valid". The difficult and "uncertain" construction of the final equation is presented as the crucial deficiency of the purely analytic method. Conversely, following "our geometrical method" or the Cartesian one, the problem is solved "in few passages of rigorous synthesis, with higher generality, certainty, and evidence". In the purely analytic method "one lacks the method to fix the most opportune directed lines [coordinates]", and "this essential shortcoming is the cause of monstrous analytic solutions"[72]. When the geometer renounces reasoning on geometrical figures and lets his intellect fly analytically, results can only be "monstruous". Later on, the authority of Newton is used to support the crucial role of geometrical constructions in problem-solving[73]. Fergola also argued for the purely intellectual nature of geometrical reasoning, and for the need of eliminating any empirical component from it. "The operations prescribed in geometry have to be executed by the mind, not by the hand" he wrote; geometrical instruments, such as compass and rule, have not to be taken as criteria for our reasoning, as they are too limited and empirical: "table geometry", which is based on instruments, "is not a science any more, but an art". The "Euclidean spirit ask for reasoning on magnitudes without interposing any manual operation"[74].

The editors also included excerpts from Fergola's lectures on Sublime Analysis. The topic is the reduction of rational functions to simple fractions. "Among the various topics contained in the summing methods of the modern geometers, no one is more elegant and complete than the integration of rational functions", Fergola began[75]. In order to accomplish the integration, the functions must be properly resolved into "convenient" elements, and this is "the most difficult part" of the whole process. Fergola referred to Euler's treatment of the topic, which he found unsatisfactory, as it lacked both rigor and clarity. The memoir is a good example of Fergola's "Euclidean program" in analysis: he tried to present Euler's results in a Euclidean form, and to provide a sound proof for them. "Euler's theories" wrote Fregola, "are presented with Ramistic method", instead they "should be reduced to a didactic Euclidean system". The calculations should be "elegant", "easily understandable", and freed from imaginary magnitudes, circular functions and other "difficult operations". So Fergola replaced certain "speculative principles" he had found in Euler with "intuitive" ones, relevant to the specific question under consideration. According to Fergola, the "light" of speculative principles is weaker because they have to differently apply to a number of objects[76]; Euler was more interested "in the generality of his solutions than in the way to obtain them"[77], but "the great generality of an argument is not a desirable thing if it causes difficulties in the solution of the most simple cases". It is instead "more convenient to have precise and clear rules" to treat the common cases and from them move clearly to the more general.

The overly polemic tone of the geometrical memoirs and the presence of Fergola's analytic work tell us that the time of the unchallenged control of mathematical practice in the kingdom was near to an end. At many points the editors refer to unnamed Neapolitan geometers who depreciated synthesis and cultivated pure analysis "furiously". No traces were left of Lauberg's school, of course, and it was no question of a single foreigner, as in the 1807 episode. Who, then, were the new analytics? Before answering this question, let us conclude our presentation of the most relevant results of Fergola's school.

6.3 Other Themes and Problems from the Synthetic School

A few other results and names should be mentioned in order to complete our presentation of the research pursued in the synthetic school. Fergola remained active until 1818, when his health greatly declined. In 1809 he published a memoir on the problems of contacts, whose original solutions —provided by Apollonius— are lost[78]. Following the examples of Viète and Newton, Fergola presented his own purely synthetic solving method, which consisted in reducing all the problems of this kind to a single lemma, which he proved. Note that these were the problems synthetically solved by Giordano, Forte and Giannattasio when the French officers of General Pommereuil visited the school in 1786. Scorza was to provide a different synthetic solution, which was considered as the most similar to the original practice of the Greek geometer.

In 1819, the Acts of the RAS included Fergola's considerations on the "Ptolemaic theorem", which expresses a metric relation between four points which are on the same circle. The theorem is relevant for trigonometry, provided that one holds a geometric conception of this discipline. Indeed, the progressive move of trigonometry from pure geometry to analytic geometry during the seventeenth and eighteenth century had deprived the theorem of its previous relevance. Fergola rescued the theorem and deduced a number of new corollaries from it, as it was "a good source of geometrical principles" which in turn can be "translated into algebraic signs" so that "they manifest many truths relative to the circular functions"[79]. These results were employed in two following memoirs, one of which regarded the reconstruction of Cotes' proof of the "cyclometric theorem", whereas in 1839 a posthumous memoir by Fergola on elliptic transcendent functions was published, where Cartesian geometrical methods were employed to calculate the differential of an arch of the ellipse[80]. "Kepler's problem" also attracted Fergola's interest[81]. In one of its versions, the problem asks for dividing a semi-ellipse according to a given ratio using a straight line passing through one of the foci, Fergola provided an approximate analytic solution for it, followed by an exact geometrical construction.

One of the most remarkable aspects of the work of Fergola's pupils was their research in the history of mathematics. It is agreed that the famous work by Montucla on the history of mathematics contained some erroneous attributions, particularly about the pre-Platonic period; but his authoritative reconstruction of Greek geometry was fully accepted by historians up to the 1830s[82]. Some of Fergola's students disagreed, though. Giannattasio, in his historical introduction to Fergola's *Conic Sections* (1810) pointed out the importance of Aristeus the Elder, and dated his activity earlier than had Montucla, who considered him a Platonic mathematician. Further investigations in the history of conic sections were pursued by Ferdinando de Luca (1783-1869), who had studied with Scorza and Fergola between 1807 and 1811 and had taught geometry, trigonometry, astronomy and geodesy at the Military School[83]. After years of research, Luca published an historical study titled *Memoir to claim back to the Italian School the entire ancient geometry* (1845)[84]. Luca pointed out a series of historical errors, due to following acritically the misleading indications of Eudemus, a disciple of Aristotle, who attributed to Plato a great number of geometrical discoveries. On the contrary, Luca attributed to members of the Pythagorean school (in which he included Menecmus and Aristeus the Elder) the invention of the methods of geometrical analysis, and the priority in the study of conic sections and geometrical loci. Doubtless the book was highly original and his historical reconstruction was substantially correct, in spite of Luca grounding his conclusions on a very dubious interpretation of a passage form Iamblicus's *De Vita Pythagorica*. It should also be noted that Luca pushed his point so far as to make Plato a mere plagiarist, and he also stated that Pythagoras birthplace was not the island of Samos, but the village of Samos, in Calabria —a thesis he found in Thomas Aquinas[85]. Luca's reconstruction of a remote "Italian wisdom" originated in the Pythagorean school was not so peculiar at it might seem. The doctrine of the ancient Italian wisdom had emerged as part of a wider reconstruction of Italian cultural identity during the fifteen century. The myth had found favour among the erudites of the sixteenth and seventeenth centuries, and was organic to the more general doctrine of the *philosophia perennis*, whose the mystically-inclined Pythagorean school was an essential element. Since 1789, political events gave new life to the myth which was employed to support revolutionary and egalitarian ideology (Marechal) as well as moderate and neo-Guelf positions (Cuoco). When Luca published his book, the myth was an important part of the conservative ideology shared by Italian Catholic middle-classes[86]. Luca published other works in history and geography, and an essay in the methodology of the history of science.

As part of the historical work of the school one should also mention the editions of Euclid's *Elements* edited by Flauti and Scorza. Flauti's editions of Euclid were dedicated to King Ferdinando I, who had granted the adoption of the text in every college of the kingdom, a privilege confirmed by the succeeding sovereigns. This assured Flauti, among other things, remarkable earnings: so that the eleventh edition could be printed in "the private-printing office of Prof. Flauti". It firstly appeared in 1810, and in 1857 the twenty-second edition went into print. In his preliminary discourse, Flauti described the work of the Greek, Arab and European glossers of Euclid, the Renaissance editions, the British editions, up to the much appreciated 1756 edition by Robert Simpson, "great practitioner and promoter of the geometry of the ancients"[87]. By contrast, the judgment on the French edition by Peyrard (1814) is very negative, he did not distinguish the real Euclidean parts from the spurious ones. Indeed, Flauti's aim is precisely that of "purifying" the *Elements*, according to the view, first expressed by Simpson, that the weaknesses found in the book cannot be attributed to Euclid, but rather to "some ancient editor of the *Elements*, misguided by the ambitious desire of innovation"[88]. Flauti thought of improving Simpson's work when he was charged by a special commission (of which Fergola was part) to prepare a textbook of elementary geometry for the colleges of the kingdom. Flauti also remarked that when he worked on his first edition of the *Elements*, "these had been largely abandoned in school, even in Italy, in favour of much less geometrically oriented institutions"[89] (it was 1810, the moment of the highest penetration of French analytic textbooks of geometry). One should note that a proof for the famous fifth postulate (the worst of Euclidean blemishes) had been introduced by Flauti in the sixth edition, to be suppressed in the eleventh. In this edition Flauti also inserted material from Archimedes *On the Sphere and the Cylinder*, which he had originally edited in 1804[90]. Flauti remarked that "a chair whose professor would explain and comment only on the works by Archimedes would be a great chair of mathematics even in our days. Every branch of these sciences would indeed be considered: geometrical invention, theory of curves, theory of series, research on infinitesimal analysis, general mechanics"[91]. It was in fact a good portrait of the teaching of his own maestro.

Scorza, not fully satisfied by Flauti's work, published his edition of Euclid's *Elements* in 1828, under the traditional title *Vindication of Euclid*[92]. Scorza aimed to emend Euclid of all the well-known errors and deficiencies, which he thought should be attributed to later interpolations. Some of his arguments have been considered as convincing to Loria[93], but his total defence of Euclid and his condemnation of everyone, modern or ancient, who disagreed with his definitions and his methods, reaches extreme and paradoxical points. What about the fifth postulate then? According to Scorza, it cannot be argued that the "very accurate Euclid" assumed this proposition as a postulate, given that he had previously provided a proof for a very similar proposition (proposition 28); it is then reasonable to assume that Euclid considered it as a lemma whose proof had not survived[94]. Consequently Scorza presented two possible proofs, where the problem is in fact moved rather than solved[95]; later he presented a third solution based on the method of limits, which was approved by the RAS in 1839, the year of the contest with the analytics[96]. Scorza's Euclid is also interesting for the didactic views it contains. Euclid's "admirable order" (i.e. progression from the more simple to the more complex, according to the "natural" sequence: point, line, surface, solid) is taken as paradigmatic, and opposed to the geometrical textbooks "of the moderns", where this "natural and proper order" is "perturbed", as they move from the general to the particular and not vice-versa (but "it is easier to conceive a point than an entire solid" he observed). Scorza argued that such inversion derives from a mistaking mathematics with empirical sciences: "here is not a question of discovering definitions by analyzing natural bodies" but rather "to dispose the truths according to the most natural way". Saying that a geometrical solid is more easily conceivable than points and lines is to mistake mathematics with empirical reality: a geometrical solid is not a physical body, and our senses are not enough to study its properties, otherwise these "very noble sciences" would "loose all their value", which consists in their being grounded "on the evidence and certainty of proof", not "on the testimonial of senses" (as physics is). And indeed Euclid "considers everything in abstract, avoiding mixing extraneous ideas [with mathematics]"[97]. The purity of mathematics, the science of abstract quantity, is defended fiercely by Scorza; being pure "they can be truly learned and taught, as their principles are stable, and their proofs are certain and evident"[98]. Interestingly, when clarifying some epistemological point, such as our knowledge of geometrical axioms —which are proposition so clear that their truth is immediately grasped "by the light of intellect"[99]— Scorza, like Luca, made use of Thomas Aquinas. He also rejected any "mechanical" consideration (of which he found many in the "moderns") as polluting the purity of geometry: "it would ground this science on the testimonial of senses", whereas it "must be completely abstract, only grounded on the evidence of reason"[100].

In Flauti's biographical note we read that Scorza was born in Calabria in 1781, and that he had reached Naples in 1795 to study medicine[101]. His uncle, "a most respectable ecclesiastic" addressed him to the study of philosophy with the "excellent maestro Capocasale"[102] and of elementary geometry with Marcello Cecere; in the early years of 1800 Scorza entered Fergola's private studio, to study higher mathematics. He obtained his degree in medicine but he never exercised the profession, as he began to teach in Fergola's studio. Here he had been trained in higher geometry, algebraic analysis and general mechanics, but his favorite topic was the "divination" of the lost methods of geometrical analysis. His most relevant work was indeed a long memoir on Greek geometrical analysis titled *Divination of the Geometrical Analysis of the Ancients, Which is the Method Used in the Greek School to Solve Problems* (1825)[103]. It consisted of three main parts: the historical reconstruction of the method; the divination of Apollonius' solution of the four-straight lines problem; and the application of the re-discovered method to a number of other classical problems. Significantly, Scorza included a problem on triangular pyramids which had been famously treated in Lagrange's analytic memoir of 1773. Also in 1825, Luca Maresca, professor at the Naval Academy and former student of Fergola, published another "divination" of Greek analytic methods, providing what he thought could be Apollonius' original solution to the problems of contacts[104]. "Everyone knows how strong was the piety and religious faith of Fergola" Flauti wrote, "and how he always transmitted it to its disciples together with science, by means of his example and of his excellent teaching"[105]. Now, Scorza was apparently the one who best responded to Fergola's religious teaching: "in the middle of so many vicissitudes, he always conducted a most exemplary life, dividing equally his day between Christian practices, teaching, and research". Scorza, "man of God, and of Mathematics"[106].

Problems over triangular pyramids were also treated by Flauti (1819), who explicitly opposed his solutions to Lagrange's ones[107]. What emerges is, once again, the irreconcilable views of the synthetics and of the Lagrangians over the real goal of geometry (i.e. specific problems versus description of very general properties of families of figures). In 1825, one of the problems treated by Lagrange and Flauti was re-considered, in different terms, by Francesco Bruno (1790circa-1862), another champion of "the methods of the ancients"[108]. This work was considered by Loria "one of the best products of the Neapolitan School"[109]; and in 1826 Jean Hachette (1769-1834) provided analytical solutions precisely for the problems solved in this memoir. Flauti read Hachette's memoir at the RAS, and triumphantly commented:

> Here is a single geometrical problem on which valid mathematicians worked for over seventy years, and which provided matter for important discussions, greatly enhancing the art of problem-solving; not only because of the variety of solutions discovered with both methods, but also because of the rules established.[110]

In 1824 Bruno, professor at the Naval Academy since 1817, had published what remains one of the finest Greek-like pieces of synthetic geometry produced by Fergola's school[111]. He provided solutions for a group of problems originated from considerations such as "trace a straight line passing through a given point and cutting a given parabola to obtain a given segment"; among the solid problems derived is Archimedes' problem about dividing a sphere according to a given ratio by means of a plane. Bruno judged his synthetic solutions particularly elegant because he employed "loci whose description and determination is the easiest possible one", and which can be directly extracted from the data of the problem, avoiding the use of "the usual solid loci" which make the solution "less natural" and imply the risk of betraying the original nature of the problem. The composition of the problem is made through the intersection of a parabola with a circle, easily determinable in the same figure used for the solution[112]. In a letter enclosed in the memoir, Flauti eulogized the "exactitude and rigor of Greek geometrizing", and accused "modern methods" of "rendering the learning of mathematics available to everyone". On the contrary, "in the Greek schools the way to geometrical invention was long and difficult, so that only a few managed to complete it"[113].

In 1827 Vincenzo degli Uberti (1791-1877), a captain of the Body of Military Engineers and professor of fortification at the Military School since 1825, published a memoir claiming priority over the solutions contained in Bruno 1824[114]. Not particularly relevant in itself, the memoir is an interesting insight into the activity of Fergola's school around 1809-1811 —when Uberti was a student at the Military School. It is also a rare testimonial of the influence of synthetic teaching upon young officers. Uberti wrote that, with Giannattasio and Sangro as professors, many became convinced synthetic problem-solvers, "so that in the corridors of the college and among the desks of the classrooms, we only meditate about synthetic solutions"[115]. Quite importantly, Uberti included Tucci, future leader of the analytic school, among his fellow students, providing evidence for Tucci's synthetic background[116].

Through Flauti we also know about the oldest of Fergola's disciples, abbé Felice Giannattasio. Son of a provincial landowner, Giannattasio came to Naples to enter the Church. He studied philosophy and mathematics, and as early as 1778 he began to study with Fergola. Flauti attributed to Giannattasio the merit of convincing the reluctant Fergola to publish his works, including the 1791 *Conic Sections* and the 1792-93 textbook of mechanics; and they would have published much more "if the political circumstances of those times" had not "perturbed our own happiness, and the improvements of all kinds that were taking place among us"[117]. Giannattasio obtained the chair of Sublime Mathematics at the Military School in 1802. In 1812 he obtained the chair of Sublime Synthesis at the RUN. He had been a member of the RAS since 1811. Apart from his collaboration with Fergola, Giannattasio worked on Wallis's cylindroid (see the 1811 collection), and published a memoir on "the quadrature of the hyperbole" (1819), where he used the method of limits, which he attributed to Archimedes (but in fact can be first found in Huygens). He was "a most respectable and exemplary ecclesiastic", and he "always avoided politics and parties", which to Flauti was "a virtue".

We can conclude with some remarks over Flauti himself. During his sixty-year long career Flauti obtained innumerable duties and honors from the Bourbons, he sat in important commissions for the control of public education, and he produced a large number of publications. Only the fall of the dynasty, in 1860, made it possible for his enemies to put him out of Neapolitan scientific life[118]. Flauti began teaching in Fergola's private studio around 1798; and he directed it with Giannattasio from 1801. In 1803 he was offered the specially created chair of Synthetic Mathematics at the university; in 1806 he moved to Algebra and Descriptive Geometry; in 1812 he replaced Fergola as professor of Sublime Analysis. In 1818 he was also nominated "first professor of mathematics" at the Royal College of Naples, teaching conic sections, sublime calculus, and mechanics. In 1822, after years of difficult work, he opened the University Library, of which he was director. In 1827 he was a member of the commission to reduce the number of university chairs. Since 1829 he was in the powerful Committee of Public Education (*Giunta di Pubblica Istruzione*), whose president was monsignor Francesco Colangelo. He often examined the candidates of the Military School, the Naval Academy, and other colleges all over the kingdom. In 1823 he was teaching descriptive geometry at the Military School. In 1808 he entered the RAS, of which he was secretary from 1817 to 1860. In 1829 he was knighted (*Cavaliere*) by King Francesco I. Significantly, in 1821 Flauti was declared a honorary member of the Academy of the Sciences of Modena, at the time the center of Reactionary Catholic thought. He also joined, among others, the academies of Copenaghen (1817), Berlin (1829), and Bologna (1845). He was personally in charge of the reform of the Naval Academy in 1817, and of the revision of the project of reform of weights and measures (1837). In addition to what we have already said, the following works should be signalled. In 1801 he translated and annotated a textbook on differential calculus by Étienne Bezout (1730-1783) for his private teaching. In 1807 he published a textbook of descriptive geometry for the School of Engineering and Artillery (which had replaced the Military Academy in 1801)[119]. The book was printed in Rome at the expense of the Neapolitan government, and it is indeed historically relevant, as it was the first Italian textbook of descriptive geometry[120]. The text followed the basic structure of Monge's textbook, but Flauti tried to make the proofs of the theorems more simple and "elegant", and to show more clearly "the geometrical nexus which links all the truths presented to the reader". In fact, Flauti's enthusiasm for the new branch of mathematics is easily understood as we recognize his attempt to make descriptive geometry a mere extension of pure geometry. The "uncertain and difficult techniques" elaborated by artists and architects in the previous centuries, we are told, are now —thanks to Monge— given generality and certainty by connection with solid geometry. They need precision and logical connections, as they are "a branch of general geometry"[121]. To this extent, the "analysis of the moderns" is useless, because it provides no method to solve the problems "of locus and position" —a category under which fall all the problems studied by descriptive geometry. Synthesis must then be revived, so that "this method, which had been abandoned with great damage for mathematics after the application of algebra to it, again shows its importance". Descriptive geometry is "entirely included in the geometry of the ancients", so it deserves "to be treated with the same rigor of Euclid's *Elements*"[122]. Flauti acknowledged the affinity between "modern analysis" and descriptive geometry, and the possibility of translating the problems in analytical terms; nevertheless "the analysis of the ancients is more proper than that of the moderns to solve these locus problems"[123]. In 1815 Flauti published a second book of descriptive geometry, titled *Plane and Solid Locus Geometry*[124]. This was Flauti's most famous book, and copies can be found in many Italian public libraries. The book is much more original in its form and content than the 1807 textbook. A historian of descriptive geometry has recently noted that, with respect to the 1807 one, this book presented "innovations of form and style which unfortunately made its reading difficult"[125]. The point is well made, and I would seek to explain it in the following way: Flauti wrote his book as he thought a Greek geometer would write it. Remember that the 1807 text was the result of the compromise with the French occupying government (i.e. with French textbooks); at that stage the purely geometrical reduction of descriptive geometry is more a program than actually performed. In 1815, with the return of the Bourbon, Flauti was free to approach the matter, which he had by then taught for ten years, in a Greek-like synthetic way, in the best tradition of Fergola's school. The result was the strange 1815 book, which diverged remarkably from contemporary Italian and French treatises on descriptive geometry. Consider the contents: the methods of descriptive geometry, defined as the science which determines figures in space, are presented after the "analogous" methods used to determine figures in plane geometry, and followed by their application to a number of problems of solid geometry. Descriptive geometry is indeed considered as a natural complement of ancient solid geometry, as it provides practical methods to construct the theoretical solutions of its problems. Among the problems considered are the ones traditionally treated in the school, such as those about Wallis's cylindroid and about triangular pyramids. The last five chapters provide a compendium of Fergola's *Geometrical Invention*, chiefly the methods of conversion and transfer, plus their application to particular problems. Descriptive geometry is in fact reduced to a branch of solid geometry, and so absorbed in the practice of Fergola's school as a useful source of constructive techniques whose primary goal is the application to the solutions of problems of pure geometry. Only secondarily are such techniques of interest to applied sciences. Flauti chose very convincing examples to state his point, such as the construction of the solution for the famous problem of Archytas, which was praised by Chasles and Allman in their histories of geometry[126]. Loria himself advised teachers to use Flauti's book to find good applications of the procedures of descriptive geometry to pure geometry, as an alternative to the usual problems in applied mathematics[127]. Also the overall form of the book is Greek-like, from the terminology ("superfici plectoidi" instead of "superfici rigate", for instance) to the form in which problems are presented. The common usage was that of stating a problem in the form of a proposition asking for the construction of a figure satisfying certain conditions to be performed. Flauti preferred instead to put them in the form of the Greek "data" ("givens"), i.e. propositions where the position of one or more entities described is not determined. A "given" is then "proved" when one shows that the determination is in fact implicitly given in the original proposition, of which it is a necessary consequence. Any problem can clearly be presented as a datum to be proved. Considering such peculiarities in the form and content of the book, it is no wonder that, compared to the 1807 elements and to contemporary textbooks of descriptive geometry, the results seemed particularly "obscure".

The case of descriptive geometry is emblematic of the original re-elaboration of contemporary mathematical knowledge made by members of Fergola's school. Flauti knew the new discipline through French books; he saw in it a source of useful techniques to construct the solutions of geometrical problems and, at the same time, a rare opportunity for synthesis to claim its role back in mathematical research. In 1807 the new French government introduced the discipline in universities and in the newly founded technical schools for training architects and engineers; it was the only synthetic part of a wholly analytic curriculum. The space for a collaboration with Flauti was open; the 1807 textbook was very much the result of such a compromise: the language and structure are those of Monge; but Flauti showed now the "Euclidean program" of the school could be extended to this discipline as well. This is actuated in 1815, when compromise with the practically and analytically oriented French curriculum was no longer necessary. According to this interpretation, the particular adoption of descriptive geometry by Flauti —like the adoption of algebraic analysis by Fergola in the 1780s and 1790s— cannot be explained by referring to his "ignorance" of French mathematics, or to his being somehow "backward"; I rather claim that members of the school selected and re-shaped parts of modern mathematics so as to suit their own scientific program. In the specific case of descriptive geometry, the "receptivity" of the synthetics brought Naples temporarily ahead of Northern Italian centers of mathematical research, (where the Lagrangian and analytical approach to mathematics was dominant).

About Flauti's remaining works, note that he published a *Course of Geometry* (1810) for the colleges of the kingdom which was reprinted (at least) twenty times[128]; also repeatedly printed were his treatise of trigonometry and his algebra (1819)[129]. The first was a valuable synthetic textbook of plane and solid trigonometry, based —not surprisingly— on the application of the Ptolemaic theorem; spherical geometry was here presented as the necessary premise to spherical trigonometry. Flauti's claim that any trigonometric formula must be translated "into words" can be puzzling, but we know that intuitive perspicuity was a necessary property of geometrical truths in Fergola's school.

In 1840, after the contest and the polemical exchange with Padula, Flauti began the publication of some significant works of the school, including some unpublished geometrical treatises by Fergola. He never managed to publish the analytic treatises of his maestro; instead, in the crucial year 1839, Flauti published a collection of Fergola's writings on religion, adding his own proof of the spirituality of the soul.

6.4 Flauti on Public Education and the Didactic of Mathematics

There are a couple of further works by Flauti which deserve particular attention: those relative to the system of public education, and to the didactic of mathematics. Note that these works were both published in the early twenties, i.e. the moment of the highest influence of the Reactionary Catholic intellectuals upon the Neapolitan government, and upon the Neapolitan culture in general. As we have seen Flauti was charged with important choices about the mathematical curricula of university, military colleges and secondary schools. The ideas guiding his choices were initially presented in his *Project for the Reform of Public Education in the Kingdom of Naples* (1820)[130]. His meditations on public education are grounded in "direct experience", and on factual knowledge of teaching material and of the institutions of education, Flauti claimed. If a reform must be made, this is to be grounded on experience, not on "vain speculations", i.e. "on the beautiful systems elaborated in recent years [the French period], which have increased ignorance instead of instruction"[131]. Flauti is hostile to the very idea of public education which, he says, "was unknown to the world until fifty years ago". Only "the very modern men", whose main feature is their wide but superficial knowledge could think of "legislating" over the entirety of human knowledge. The result of this ambitious program has been the "disappearance of the depth of education, which has been reduced to a mere strata of paint", and in the future "this evil will only be increasing". This was how Flauti reacted to the changes in education after the French experience (1806-1815) and the moderate government of Medici (1815-1820). And here was the remedy he offered, "according to my —possibly strange— way of thinking"[132]. Flauti polemically recognised the anachronistic aspect of his opposition to "the ideas of the century". The point is that in 1820 the related counter-revolutionary battles of men like Flauti (in public education), Ventura (in the Church) and Canosa (in politics) could still be won, as very concrete interests were supporting their ideas. The prospect of reform presented by Flauti had one major characteristic: it perfectly fitted the system of knowledge elaborated by Reactionary Catholic philosophers. Its aim was to restore traditional pre-encyclopedic curricula and methods of teaching. The crucial fact that Flauti, like every other reactionary author, was largely re-inventing such a "tradition" never emerged, of course. Flauti seems to refer to some idyllic pre-

Revolutionary world, which he in many points evoked by using the expression "fifty years ago".

Let see how his prospect was organic to the Reactionary culture. First of all the notion of education was given a very wide connotation, meaning the whole process the young must go through to become "honest and good citizens"[133]. The primary goal of public education is indeed a moral one. It follows that it is meaningless to separate the transmission of scientific knowledge from that of religion and of the morals. And it is precisely "the moral corruption of our days" that is the greatest obstacle to the good working of public education[134]. Moral corruption begins very early, as the young child is detached from his family to be educated (remember Leopardi's successful opposition to "corrupting" nurseries). Children must remain with their own family at least until they are eight years old, as family is "the first origin of virtue", the attachment of a child to the family being the original model for the attachment of a citizen to monarchy and divinity. The example of parents is the first and most natural form of education: moral and religious truths would be taught in vain if this example was lacking. The state must intervene to reduce moral corruption and to spread the reading of the Gospel in the family, as it is the source "of the more perfect morals". Bishops should use "every possible means" to "supervise" parents in their teaching children "religious doctrines"[135]. On this basis elementary education can operate, by teaching eight-years old children to write, to read, and some arithmetic. Writing and reading should be done on texts from the Old Testament, so that children learn, through enjoyable tales, the history of their religion and the precepts of the most perfect morals. The choice of teachers must be left to local authorities, "the government avoiding intervening in any way" —this passage should be noted, as it opposes the centralization and bureaucratization of teaching accomplished by the French government in the Neapolitan kingdom[136]. Twelve-year old children should then be offered ("not forced") entry to the College (*liceo*), where a "universal" education is provided, regardless the specific profession the child is wanting to enter. The college's curriculum must include Greek, Latin and Italian literature, history and geography, logic and metaphysics, pure geometry and trigonometry, algebra and analytic geometry, experimental physics and chemistry. Private schools should be granted their rights (Flauti eulogized the Jesuit colleges as example of high-standard private schools[137]). Anyway secondary education is not necessary for the good of the state, as "being ignorant does not cause moral corruption". The eighteen-year old student willing to continue study can then enter either a "special school" or university. "Special schools" are of three kinds, each one training for a specific profession: notary and barrister; physician and surgeon; civil architect. The medical school should return to the Hospital of the Incurables, which in the past produced "a most respectable medical class". Describing the chairs which should be established in each school, Flauti wrote ironically of "the recent progresses of the human spirit", and remarked:

> Enlightenment and modern civilization made many educated people, but very few wise people; the extension of knowledge is indeed inversely proportional to its depth, and we will finally reach an epoch where everyone will equally know nothing.[138]

For this study is significant the description of the Special School for Civil Architects. Its chairs should have been: geodesy; sublime analysis; mechanics; geometry of site and its applications; civil and hydraulic architecture; constructions. The knowledge of civil engineers should have been essentially geometrical, and their science is conceived as geometry applied to constructions. Flauti attributed to local authorities the right to train their own land-surveyors, without sending them to the special school in Naples[139]. In 1820 this was a very meaningful statement to make, as the debate over the competencies of the central government was intense. Theological colleges are out of the competence of the state. Flauti then moved to the ideal structure for the university, whose main goal is to produce professors for the colleges and special schools. "The university, including every branch of human knowledge, must be divided into the following faculties: Theology; Law; Medicine; Mathematics and Natural History; Literature and Philosophy". The print of reactionary philosophy is clear on such a hierarchy of faculties, which reflects a hierarchy of knowledge based on the dominant and pervasive presence of religious and metaphysical knowledge. Flauti's project echoed in many ways Poli's 1805 project, whose full actualization had been prevented by the French occupation of the kingdom in 1806: three theological chairs on top of a pyramid (Holy Scripture, History of the Councils, Dogmatic Theology), four chairs of law, seven of practical medicine, surgery and anatomy, two chairs of pure mathematics (sublime analysis and sublime synthesis), one of mechanics, one of experimental physics, and then chemistry, botany, zoology, mineralogy, and astronomy. Flauti advised professors always to make clear to students the connection between their discipline and the others; and to "never detach the history of a discipline from its presentation", as past treatments of a certain matter are essential part of our present knowledge of it[140]. Among the duties of professors was also the indication of those books which are "dangerous" to students. As method of assessment Flauti criticised the recent introduction of oral presentations (*conferenze*) and defended what in fact was Fergola's own method: to propose specific questions for the student to deepen and solve, in the form of a scientific essay. Flauti described the hierarchical structure of the professorial group, and the path an academic career should normally follow. His point is clearly to oppose the progressive bureaucratization of the academic profession, the assimilation of professors to other groups of civil servants. A passage about the present "deterioration" of university is worth quoting:

> Until twenty-five years ago this country had only two classes of people, the wise and the ignorant; then the concourse for professorship provided the university with excellent professors, as only about ten well-practiced professors turned up, whom the people already knew and respected because of the number of their very good pupils.[141]

"Since this line of demarcation has been eliminated" Flauti continued, "everybody who has studied the elements of a science is believed to be a wise man" and a crowd of candidates appear for every competition. Often the new professors have no experience of teaching at all. Flauti's reference to Fergola's school is clear enough. Flauti concluded with a detailed treatment of the military schools: military college and academy (curricula for officers, and for members of the Corp of Engineers and Artillery) and naval academy. Mathematical training seems analogous to that of civil architects, the basis being sublime geometry and its "practical applications".

We can now leave the *Project* to look at a more specific essay: *Dissertation on the Method in Mathematics, the Way to Order the Elements of These Sciences, and to Teach Them* (1822)[142]. This will help us to conclude our description of the synthetic school during the 1820s-1830s, and to integrate the school in the changing institutional and cultural panorama of the period. The tone of the essay, originally a series of memoirs read at the RAS, is overly polemical. Flauti attacked those who have only a superficial knowledge of mathematics and yet write textbooks of these sciences; he talked of "some military", clearly officers of the Engineering Corp, and of teachers who have not produced valuable students. These are people who know "this science only by means of those few applications needed in the trivial exercise of their profession", and who pretend "to teach only that bit which is useful for such a purpose", holding that "everyone should learn as much as he likes of parts such as the elements of geometry". "I have heard plentiful of stories from this class of people" he continues, "about the fact that we Mathematicians want, with our method, to create wise people and not professionals"; the essay was designed to make things clear.

The historical introduction presented a reconstruction of the history of mathematics which is already familiar: Renaissance of Mathematics based on the rediscovery of Greek texts; Italian algebraists and geometers, Galileo, Descartes, Newton ("who perfected the methods of approximation of the Greek school"[143]), and the long list of seventeenth-century mathematicians; but the result of such a flourishing of mathematics was the beginning of their "decadence", which dates from the eighteenth century. More and more people studied these sciences, and they were inserted in many university and professional curricula as secondary disciplines: for the first time in history "they were not the exclusive patrimony of those who pursued them for passion". This was not progress, it was indeed the contrary. "Learning these sciences is now easy", but the very methods which made it easy are corrupting the original purity of mathematics: "the bad teaching methods, the variety of research, the difficulty of choosing the most proper method to treat each question, are very great obstacles to the progress of human spirit, as they make it difficult to see with a single look what has been done". Another despicable condition "of our time" is that

> no one remains in the limits of that part of knowledge which he cultivates, and where only he can be useful and distinguished; on the contrary, everybody tries to mix up with matters he doesn't know, or knows superficially, as instrumental to his profession: and this happens very easily in the mathematical sciences, as they have so many branches a single man cannot understand all of them at the same time, in spite of their being originated from a single trunk.[144]

No single man, especially today, can truly "know" more than a couple of the many branches of the mathematical sciences, each one having its own methods, goals and problems. In the following Flauti treated the "real meaning" of the term "method" in mathematics. It is worth going briefly through this once again. Flauti was convinced that Greek geometers "greatly surpassed the moderns" in problem-solving. Their methods were geometrical analysis (which discovers the "essence" of the geometrical truth in question) and synthesis (which proves the discovered truth). Extremely skilled in the use of these methods, "they extended their art to the solution of problems of whatever nature" (i.e., of whatever grade). What is most important is that they never stopped at the analysis of the problem, "a monstrosity which can be observed in the very modern works of analytic geometry"[145]. Flauti described their analysis, which could be either simple —directly solving the problem in question, or by loci —reducing the problem to that of finding the intersection(s) of certain curves. To learn these methods, the accurate study of the ancients is essential. It is opposed to modern mathematics, "which is losing its [geometrical] nature", and is being reduced to "a science of words"; whereas, as we know, pure geometry has to be a "perspicuous", "intuitive", a-linguistic science. A science of words can only produce discursive knowledge, which is necessarily the result of human "reasoning", not of the act of perception-recognition of the human intellect. The result of the confusion between these two essentially different activities, and of the two different kinds of knowledge produced by them, is that "one believes oneself able to solve problems just because he writes a few formulas on a piece of paper"[146]. The very fact that the proper method of mathematics was never an issue before the seventeenth century is a clear sign to Flauti that the ancients and the geometers of the Renaissance belonged to one and the same tradition, which was complete and perfect in itself. Since Descartes the choice between the ancient and the modern method began to be discussed, but leaving undisputed the necessity for the construction of the solution. The analytic treatment of the curves and of the geometrical loci were two of the positive results of the application of the new algebraic method to geometry, as masterfully shown in Euler's works. Infinitesimal methods were the highest and most original point reached by the moderns, and these were in fact "the real modern methods". All the following purely analytic research made the learning of these methods and their application easier, but it did not add new "methods" worth their name. The term "method" has always meant "a system of scientific principles which proves fruitful in mathematical discovery"; it is only recently that it has been "abused" to mean "the manipulation and application of formulas" [147]. The great extension of mathematical studies made it possible "to lose sight of the origin to which one should continuously return", particularly "in the branch of algebraic-analytical geometry". Here Flauti referred mainly to "the illustrious Lagrange, whose name will always be uttered with great respect in the history of mathematics for his sublime genius and for the analytic methods he invented, but whose works should not be taken as a model"[148]. In fact, Lagrange's "method consists in defining through the deepest abstraction the geometrical properties of the points satisfying the problem, without using the figure at all, and without referring such properties to the correspondent loci algebraically expressed". One who knows the art of problem-solving must be "surprised" by this "very abstract path", this product of the mind of a "sublime analyst" which is —in fact— "useless to science"[149]. The discovery of the point, the combination of the loci's equations and the construction of the final equation, prove to be very difficult, as they are conducted "in absence of light". So that what Lagrange leaves to the reader as a matter of mere calculation is precisely the essential part of the solution to Flauti, and it is certainly *not* a matter of mere calculation to his own eyes. Note again the metaphor of light, to stress the intuitive, a-linguistic, intellectual nature of geometrical reasoning as opposed to the mechanical nature of the purely analytic method; ultimately it reduces to providing a list of "equations of condition" to describe the properties of particular lines or surfaces under study, and to combine them according to mechanical rules. Here is how "analytic geometry has been reduced to a simple lot of letters, symbols and formulas"[150]. Flauti concluded by addressing the supporters of the analytic method in textbooks: "their mathematical knowledge begins where it should end up, so that they are without foundation, tottering". He made a pessimistic forecast: "mathematics will decay because nowadays everybody believes they know it after having studied its elementary parts" and because so many pretend to be "reformers of the teaching methods, destroying the good tradition and replacing it with false systems and bad textbooks"[151]. Flauti's essay on methods in mathematics was followed, in the same publication, by an essay on the proper order to present the pupils with the elements of mathematics. The duty of the author of elementary textbooks is most difficult and should not be underestimated, as one must define the concepts with "exactitude and precision"; order the matter "with rigorous method"; and present the whole field as a "picture", where everything must be captured "at a glance", "from the first to the last ring, without missing any intermediary one"[152]. On top of this, the authors of textbooks must be able to single out every time the most elegant solution among the many possible ones for a problem. No surprise that "in twenty-two centuries the geometrical part of mathematics had only one perfect institution, Euclid's *Elements*"[153]. The goal of geometrical textbooks must be "transmitting the art of invention" ("science *par excellence*"), with rigour and order. To this extent, one must doubtless begin with the elements of geometry presented according to the method of the ancients, that is to say: "the first book a pupil must have in his hands, if he wants to start with the right step, is Euclid's *Elements*"; "this system has been followed with great success by the schools in Italy, England and Germany, and if recently some on the continent abandoned it, this only resulted in confirming the uselessness of any, even minimal, change". Even those schools where only elementary geometry is taught should adopt Euclid, as it has the healthy result of "making the spirit used to precision and rigor", supplying to the training usually provided by that part of logic which deals with method[154]. Rigorous synthetic method must be integrated with a gradual stimulation of "the spirit of research" in the pupil, through exercises which provide generalizations and simple applications of geometrical truths ("invention must be reached gradually"[155]). After this stage, geometrical knowledge must be "consolidated" through research in pure geometry, ordinarily the theory of conics. The properties of conic sections must be presented synthetically, showing the immediate link with the elements. The student can now move to Euclid's *Book of Data*, and to Archimedes' and Pappus' passages on the solution of the loci, and to the works of modern cultivators of pure geometry, in order to be trained in problem-solving (this part being also covered by Fergola's *Geometrical Invention*). In the end, any branch of geometry must be treated according to the method of the ancients. On the other hand the teacher must show where modern analysis can be useful, and how it should be used (and again the metaphor of "the two wings" which, after such a panegyric on the synthetic method, seems rather out of place). The goal of the training is the "proper use" of each of the two methods, which is indeed "the main art of the mathematician", and which ultimately consists in using the support of algebra only when geometrical analysis proves extremely difficult. Cartesian analysis must be taught as "the true method", the "basis" of the application of algebra to geometry; Lagrangian analysis must also be taught, but "clearly showing how limited its use must be"[156]. About the teaching of "algebraic calculus", Flauti shows little interest, and his ideas are a pale reflection of Fergola's old ones (looking at his *Algebra,* it seems that Flauti's direct knowledge of analysis did not go beyond Lagrange). He prevented the teacher from using those textbooks where the theory of the calculus was presented without the necessary rigour, and on the basis of examples rather than proofs. Flauti concludes with mechanics, which should follow higher ("sublime") analysis in the curriculum. Mechanics shouldn't be taught only in the form of "pure and very abstract formulas, as if mechanics would abhor geometry"; instead its geometrical nature should be clearly shown. Geometry is in fact the "trustworthy interpreter of nature", which provided us with "the true laws of the world"; with respect to that, algebraic calculus only refined the fundamental discoveries of geometry. Consequently, Flauti rejected those textbooks which are "overly abstract", as —note this passage—"mechanics is not an abstract science, it must be used for empirical applications; and even if nature is ruled by general laws, the particular elements to be considered in each case are practically infinite, and it is impossible to understand all of them in a single calculation"[157]. The polemical referent is again this time implicitly, Lagrange, whose mechanics is accused of being so abstract that the "descent from his sublime considerations to the fact" is hard enterprise for the average mathematician. Again, we have the metaphor of the entirely human "analytic flight" as opposed to the concrete geometrical intuition. And, as in his trigonometry, Flauti despised those who present the truths of mechanics in the form of formulas from the very beginning, "without accompanying them with the corresponding statement"[158]. Formulas are to be preferred only when the mechanical truth includes a large number of different elements (which confirm that Flauti admitted algebra only as an economic tool). At this stage the student can be taught special courses relative to the professions (engineers, architects), "without damaging science itself", as we are only dealing with applications. The reader may wonder how technical schools could possibly damage "science itself". This is crystal clear to Flauti: through promoting "special textbooks" and differentiated courses of mathematics for their own students. "What does this specialty consist in?" Flauti asks; and he replies that one cannot abandon the rigor of proof, the elegance of solutions, or the evident connection between propositions; on the other hand one cannot abandon any part of the curriculum without "breaking the entire chain [of truths], and destroying the method itself".

> Strange and meaningless research it is that aims to prepare special institutions of mathematics, as if there was more than one way to properly learn them, and as if the principles of a science could be differently known according to personal taste.[159]

The reactionary sees boundaries falling apart, the corruption of the sciences and of morals, and the decline of true knowledge until its final disappearance amongst the profane crowd (the new class of the haughty pseudo-intellectuals). In the early 1820s, men like Ventura, Canosa and Flauti were fighting their anti-modern battle against powerful enemies. It was no longer 1799. We have already described the battle supported by *The Ecclesiastic Encyclopaedia*, which was theological (for Lammenais against Gallicanism and the "diplomatic" line), political (for the hard-liner conservatives against moderates and liberals), and cultural (for the pre-eminence of a specific structure of knowledge). Now, what is left is to reconstruct the mathematical knowledge of Flauti's adversaries. Indeed, although he named no names here, everything suggests that there was, by 1820, a real opposition to the plans of the synthetic school[160].

Notes to chapter six

1 In addition to Ventura, *Elogio di Nicola Fergola*, and [Telesio], *Elogio di Nicola Fergola*; see Tommaso Marchi, *Elogio funebre di Nicola Fergola* (Naples: 1824); and Vincenzo Flauti, *Elogio storico di Nicola Fergola* (Naples: 1824).
2 Marchi, *Elogio di Fergola*, pp.10-11.
3 Ibidem, p.17.
4 Ibidem, p.7.
5 [Telesio], pp.16-17.
6 See two anonymous inventories of the library, both at the National Library of Naples (*Inventario della libreria*, 3 vols., 1822, manuscript, ms.XVIII.19-20; and *Catalogue raisonné*, 6 vols., 1826, manuscript, ms.XVIII.13-18). The library was sold at the death of Francesco Berio (1820), and later it was dispersed.
7 On Caravelli and his teaching see Amodeo, *Vita matematica napoletana*, vol.1, pp.104-116.
8 Telesio, p.22.
9 Among them, Telesio cited one by the friend of Genovesi Giuseppe Orlando (1712-1776), the *Sectionum conicarum tractatus* (Naples: 1744), which is in fact very short and elementary; and one by the Tuscan Domenico Bartoloni (?-1798), who lived in Naples and there

published his *Meccanica sublime dimostrata coll'algebra* (Naples: 1765). Even the Euclid edited by Pietro di Martino is criticized by Telesio, as it was too rich in "artificial symbolism".
[10] The title of the dissertation was *Nicolai Fergola Solutiones Novorum Quorundarum Problematum Geometricorum*. Telesio considered this as the work that "made Naples come back in Europe".
[11] Antonio Genovesi, *Elementa Physicae Experimentalis usui Tironum aptatae auctore Antonio Genuensi P.P., accedunt nonnullae dissertationes Physico-Mathematicae conscriptae a Nicolao Fergola* (Naples: 1779).
[12] "[E]st enim natura physica quasi basis et fundamentum moralis" Fergola wrote in Genovesi, *Elementa*, p.4.
[13] Idem.
[14] Ibidem, p.45.
[15] Nicola Fergola, "Risoluzione di alcuni problemi ottici", *Atti della Reale Accademia delle Scienze e Belle-Lettere di Napoli dalla fondazione sino all'anno MDCCLXXXVII*, single volume (Naples: 1788) pp.1-14.
[16] Nicola Fergola, "La vera misura delle volte a spira", *Atti RAS*, pp.65-84.
[17] Ibidem, p.79.
[18]Fergola, "Nuovo metodo da risolvere alcuni problemi di sito e di posizione", *Atti RAS*, pp.119-138.
[19] Ibidem, p.120.
[20] This can contribute to make sense of the protection offered by Medici to Giordano and to the Academy in the summer of 1792. On the controversial relation between Medici and the Neapolitan Jacobins see Nicola Nicolini, *Luigi de' Medici e il giacobinismo napoletano* (Florence: 1935).
[21] Nicola Fergola, "Nuove ricerche sulle risoluzioni dei problemi di sito", *Atti della RAS*, pp.157-167.
[22] Annibale Giordano, "Considerazioni sintetiche sopra un celebre problema piano e risoluzione di alquanti altri problemi affini", *Memorie matematiche e fisiche della società italiana delle scienze, detta dei XL*, 1786, 4:4-17.
[23] Chasles, *Aperçu historique*, p.328.
[24] Lazare-Nicolas Carnot, *Géométrie de position* (Paris: 1803) p.383. Giordano is called "Oltajano", which is a misspelling his birthplace, Ottaviano, near Naples.
[25] *Opuscoli matematici della scuola del Sig. Fergola, parte già pubblicati e parte inediti* (Naples: 1811) pp.1-11.
[26] Letter dated 15th July 1786. Quoted in Amodeo, *Vita matematica napoletana*, vol.2, p.12.
[27] Giovanni Leonardo Marugi, who was a physician. With regard to this episode, Amodeo remarks: "according to the statute, the fact of not being promoted from ordinary to pensionary member was *a sign of disgrace*"; Amodeo also remarks that Fergola's former teacher, Marzucco, was unwilling to support him in this occasion (Amodeo, *Vita matematica napoletana*, vol.2, p.13). Note that Saladini had become pensionary member in 1783.
[28] See [Telesio], *Elogio di Fergola*, pp.59-61.
[29]Domenico Caracciolo was indeed ambassador of the King of Naples in Turin (1754-64), London (1764-71), and Paris (1771-81). From 1781 to 1786 he was Viceroy of Sicily, then Prime Minister in Naples until his death (1789). On his life and thought see Benedetto Croce "Il Marchese Caracciolo", in Croce, *Uomini e cose della vecchia Italia* (Bari: Laterza, 1956).
[30] See Michelangelo Schipa, "Il secolo decimottavo", in *Storia della Università di Napoli*, p.463.
[31] On the episode see [Telesio], *Elogio di Fergola*, pp.78-79 (Telesio misspell the name as "Pommereoil"). François Pommereul (1745-1823) moved to Naples in 1787 to reform the artillery of the Kingdom, and continued there his career until the early 1790s, when Naples entered the anti-French coalition.
[32] [Telesio], *Elogio di Fergola*, pp.199-200.
[33] This manuscript piece by Fergola is quoted in [Telesio], *Appendicetta*, p.28; and in Amodeo, *Vita matematica napoletana*, vol.2, p.60.

[34][Nicola Fergola], *Istituzioni delle sezioni coniche ad uso dei collegi e delle scuole del regno illustrate dal rev. sacerdote D. Felice Giannattasio* (Naples: 1791); reprinted in 1811 and 1817.
[35] [Telesio], *Elogio di Fergola*, p.36.
[36] Nicola Fergola, *Trattato analitico delle sezioni coniche* (Naples: 1814) p.xiv.
[37] Nicola Fergola, *Trattato analitico dei luoghi geometrici* (Naples: 1818). For the originary version of the problem of the four straight lines, see Pappi Alexandrini, *Collectionis quae supersunt e libri manu scripsit edidit, latina interpretatione et commentariis instruxit F. Hultsch* (Berlin: 1876) vol.2, p.676.
[38] Nicola Fergola, *Della invenzione geometrica. Opera postuma di Nicola Fergola ordinata compiuta e corredata d'importanti note dal prof. V.Flauti. Parte I* (Naples: 1842).
[39] See the letter of appointment in [Telesio], *Elogio di Fergola*, p.201.
[40] Ibidem, p.80.
[41] Ibidem, p.15.
[42] [Telesio], *Appendicetta*, p.18.
[43] Ibidem, p.27.
[44] See [Telesio], *Elogio di Fergola*, pp.106-108.
[45] Ibidem, p.82.
[46] Ibidem, p.83.
[47] See the letter of King Ferdinando to Cardinal Fabrizio Ruffo after the "liberation" of Naples, in Zazo, "L'ultimo periodo borbonico", p.469.
[48] From a royal dispatch of August 1799, in Zazo, "L'ultimo periodo borbonico", p.470.
[49] See ibidem, pp.470-472.
[50] Letter dated 14 March 1800, in [Telesio], *Elogio di Fergola*, p.84.
[51] See [Telesio], *Elogio di Fergola*, p.86.
[52] On the members and the activity of this under-researched academy see Antonio Piolanti, *L'Accademia di Religione Cattolica. Profilo della sua storia e del suo tomismo* (Vatican City: Libreria Editrice Vaticana, 1977).
[53] These episodes, wrote Telesio, "could make laugh the young men educated in the French way, i.e. according to the bestial ideas of il Signor de Ametrie [de La Mettrie] and of Elvezio [Helvetius], and those who are always young in their mind..." (*Elogio di Fergola*, p.177).
[54] On Giuseppe de Sangro (1775-?) no biographic sketches are available. We know that he studied with Giordano, that he taught in the Military Academy, and that he was a member of the RAS from 1807. From 1811 he suffered a "mental illness" which prevented him from working.
[55] Letter reprinted in Flauti, *Servizi resi*, p.3.
[56] *Opuscoli della scuola del Sig. Nicola Fergola, parte già pubblicati e parte inediti* (Naples: 1811).
[57] *Opuscoli*, p.v.
[58] Ibidem, p.vii.
[59] Giordano, "Risoluzioni di alcuni difficilissimi geometrici problemi", ibidem, p.1.
[60] Ibidem, p.3.
[61] Ibidem, p.13.
[62] Ibidem, p.17.
[63] Ibidem, p.27.
[64] See ibidem, pp.33-34.
[65] Stefano Forte, "Risoluzione del celebre problema della cilindroide di Wallis con altre ricerche affini" (1797) ibidem, pp.97-110. Stefano Forte (1770-1818) was a poet, and a lecturer of philosophy in the seminar of Sessa. He was highly regarded by Fergola, who asked him to write the "prenozioni geometriche" to his *Prelezioni* (see vol.1, pp.vii-xxiv; and vol.2, pp.v-xiv).
[66] Incidentally, Fontana entered our history in 1796, when he met the Neapolitan exiles Lauberg and Flaminio Massa in Milan; in 1799, at the fall of the Cisalpine Republic, Fontana was imprisoned (he avoided the deportation because of his age). He was accused of having worked for the Republic, and he was suspected of being the author of the anti-religious book *Istoria dello stabilimento della religione cristiana*, published in Pavia in 1796. Fontana admitted

he had only written the preface; the author of the text, as we noted above, was probably Massa himself.

[67] Forte, "Risoluzioni", p.98.

[68] [Nicola Fergola], "Estratto dall'*Arte Euristica* di un nostro geometra. Ed ha per oggetto I problemi *de inclinationibus* universalizzati, che si posson dire delle applicazioni", ibidem, p.128.

[69] Ibidem, p.129.

[70] Ibidem, p.145.

[71] The "stranger" was the well-known Piedmontese Giovanni Plana (1781-1864), who visited Naples in 1807 in order to obtain a chair of analysis from the French government (see Amodeo, *Vita matematica napoletana*, vol.1, p.146). Plana had studied at the École Polytechnique of Paris with Lagrange and Monge. In 1811 he became professor at the University of Turin, and the director of the astronomical observatory of that town.

[72] [Fergola], "Estratto dall'*Arte Euristica*", pp.181-182.

[73] Ibidem, p.190.

[74] Ibidem, p.192.

[75] [Nicola Fergola], "Estratto da un manoscritto di analisi sublime di un nostro geometra", ibidem, p.37.

[76] Ibidem, p.69.

[77] Ibidem, p.71.

[78] Nicola Fergola, *I problemi delle tazioni risoluti con nuovi artifizj di geometria dal professore di matematica sublime N.F.* (Naples: 1809). The text was followed by a historical essay by Flauti. It was reprinted in *Atti della RAS*, 1819, 1:1-19.

[79] Nicola Fergola, "Dal teorema tolemaico ritraggonsi immediatamente I teoremi delle sezioni angolari di Vieta e Wallis e le principlai verità proposte nella trigonometria aanlitica dei moderni", *Atti della RAS*, 1819, 1:205-247.

[80] Nicola Fergola, "Su la rettificazione dell'ellisse e gli integrali che ne dipendono, estratta dai manoscritti del defunto Nicola Fergola e presentata all'Accademia da Vincenzo Flauti", *Atti della RAS*, 1839, 4:13-23.

[81] See [Fergola], "Estratto dall'*Arte Euristica*", in *Opuscoli*, p.171, for instance; and Nicola Fergola, "Il problema di Keplero risoluto dal fu illustre geometra Nicola Fergola", *Memorie della RAS*, 1857, 2:156-164. Scorza provided another solution for successive approximations (Giuseppe Scorza, "Metodo per rinvenire l'anomalia eccentrica data la media del fu nostro socio G.Scorza", ibidem, pp.165-172).

[82] See, for instance, his influence on works such as Chasles, *Aperçu historique* (1837). Loria notes that also the memoirs on Eudoxus published by Ludwig Ideler (1766-1846) in the Acts of the Academy of Berlin (1828-30) took for granted the historical interpretation offered by Montucla (see, Loria, *Nicola Fergola*, p.16). Ideler was also the author of a *Handbuch der Mathematischen und Technischen Chronologie*, 2 vols. (Berlin: 1825-26).

[83] Luca published his lectures as *Planometria*, 2 vols. (Naples: 1813,1815), which included plane trigonometry and plane geometry.

[84] Ferdinando de Luca, *Memoria per rivendicare alla scuola italica tutta l'antica geometria, cioé l'analisi geometrica, le sezioni coniche e i luoghi geometrici* (Naples: 1845). Originally read at the Accademia Pontaniana in 1832 and, in 1840, to the Seventh Congress of the Italian Scientists.

[85] Luca, *Memoria*, p.11.

[86] On this myth and its political uses, see Paolo Casini, *L'antica sapienza italica. Cronistoria di un mito* (Bologna: Mulino, 1998).

[87] Vincenzo Flauti, *Gli Elementi di geometria di Euclide, emendati in que' luoghi in cui una volta furono viziati da Teone, o da altri; e ne quli sono restituite alcune definizioni, e dimistrazioni dello stesso Euclid*e (Naples: 1827; orig.ed. 1810) p.xlvii.

[88] Ibidem, p.xvii.

[89] Ibidem, p.lii.

[90] Vincenzo Flauti, *Elementi di geometria solida* (Naples: 1804).

[91] Flauti, *Elementi di Euclide*, pp.359-360.

[92] Giuseppe Scorza, *Euclide vendicato, ovvero gli* Elementi *di Euclide illustrati ed alla loro integrità ridotti* (Naples: 1828).
[93] Loria, *Nicola Fergola*, p.97.
[94] See Scorza, *Elementi vendicato*, p.50.
[95] Ibidem, pp.91-95.
[96] See Vincenzo Flauti, *Prospetto ragionato delle opere componenti un corso di studi matematici per la istituzione in tali scienze, l'invenzione e il perfezionamento* (Naples: 1841) p.12. The proof was published as Giuseppe Scorza, "Nuova e semplice dimostrazione del principio fondamentale delle parallele corrispondente all'esatta nozione di tali rette data da Euclide", *Atti della RAS*, 1852, 6:1-9.
[97] Scorza, *Euclide vendicato*, pp.ii-iv.
[98] Ibidem, p.1.
[99] Ibidem, p.35.
[100] Ibidem, p.45.
[101] Vincenzo Flauti, *Elogio di Giuseppe Scorza* (Naples: 1843).
[102] Ibidem, p.2.
[103] Giuseppe Scorza, *Divinazione della geometria analitica degli antichi ovvero del metodo usato dalle greche scuole nella risoluzione de' problemi* (Naples: 1825).
[104] Luca Maresca, *Memoria del prof. Luca Maresca in cui il metodo analitico degli antichi si applica alla risoluzione di vari difficili problemi, e di quelli specialmente che disconsi delle tazioni* (Naples: 1825).
[105] Flauti, *Elogio di Scorza*, p.10.
[106] Ibidem, p.11.
[107] Vincenzo Flauti, "Soluzioni geometriche di alcuni principali problemi sulla piramide triangolare", *Atti della RAS*, 1819, 1:52-70.
[108] Francesco Bruno, "Ricerche geometriche sopra un difficile problema di sito", *Atti della RAS*, 1825, 2:29-40.
[109] Loria, *Nicola Fergola*, p.72.
[110] In appendix to Jean Hachette, "Solution algébrique d'un problème de géometrie à trois dimensions", *Atti della RAS*, 1832, 3: 3-34.
[111] Francesco Bruno, *Soluzioni di geometriche di alcuni difficili problemi solidi condotte a fine col metodo degli antichi geometri, per servir di guida alla gioventù matematica che desidera in esso esercitarsi* (Naples: 1824).
[112] See ibidem, pp.iii-iv.
[113] Ibidem, p.vi.
[114] Vincenzo degli Uberti, *Esercitazioni geometriche* (Naples: 1827).
[115] Ibidem, pp.7-8.
[116] See ibidem, p.10. Uberti was also known for his Italian translations of Humboldt's *Cosmos* and Shakespeare's *Hamlet*.
[117] Vincenzo Flauti, *Elogio dell'abate Felice Giannattasio* (Naples: 1850) p.7.
[118] A list of duties and publications up to 1848 was provided by Flauti himself in his *Servizi resi*.
[119] Vincenzo Flauti, *Elementi di geometria descrittiva* (Rome: 1807).
[120] Flauti had been himself teaching this discipline since 1801, after having read Monge's *Geometrie Descriptive*. The manuscript of the 1807 textbook had been originally prepared by Flauti for his colleague Luigi de Ruggiero (1779-1851), former pupil of Fergola, who taught at the new Military School until 1811, when he was offered the chair of mechanics at the RUN. From 1807, at the RUN, the discipline was officially taught by Flauti himself.
[121] Flauti, *Geometria descrittiva*, p.vi.
[122] Ibidem, p.vii.
[123] Ibidem, p.34.
[124] Vincenzo Flauti, *Geometria di sito sul piano e nello spazio* (Naples: 1815); reprinted in 1821 and 1842.

[125] Alessandra Fiocca, "La geometria descrittiva in Italia, 1798-1838", *Bollettino di storia delle scienze matematiche*, 1992, 12, p.219.
[126] George Allman, *Greek Geometry from Thales to Euclid* (Dublin-London: 1889) p.119.
[127] See Loria, *Nicola Fergola*, pp.105-106.
[128] Vincenzo Flauti, *Corso Geometrico*, 2 vols. (Naples: 1810); later editions were in four volumes.
[129] Vincenzo Flauti, *Della trigonometria rettilinea sferica, libri sei* (Naples: 1830); this is the eleventh edition; the first edition dated probably around 1810. Vincenzo Flauti, *Analisi algebrica elementare. Parte 1: l'algoritmo algebrico e l'analisi determinata* (Naples: 1819); reprinted in 1824 and 1830.
[130] Vincenzo Flauti, *Tentativo di un progetto di riforma per la pubblica istruzione nel Regno di Napoli* (Naples: 1820); the essay was published by the Naval Academy Printing Office. Flauti had been asked by the recently restored Bourbon government to present an "organic reform" of the entire curriculum of the academy in 1817, and it is likely that these more general reflections stemmed from this experience.
[131] Ibidem, p.4.
[132] Ibidem, p.6.
[133] Ibidem, p.7.
[134] Ibidem, p.8.
[135] Ibidem, p.11.
[136] Ibidem, p.12.
[137] Ibidem, p.15.
[138] Ibidem, p.20.
[139] Ibidem, p.22.
[140] Ibidem, p.26.
[141] Ibidem, p.30.
[142] Vincenzo Flauti, *Dissertazioni del metodo in matematiche, della maniera d'ordinare gli elementi di queste scienze e dell'insegnamento de' medesimi, con appendice che contiene una esposizione del corso di matematiche del professore Flauti* (Naples: 1822).
[143] Ibidem, p.8.
[144] Ibidem, p.10.
[145] Ibidem, p.12.
[146] Ibidem, p.14.
[147] Ibidem, p.19
[148] Ibidem, p.20
[149] Ibidem, p.21.
[150] Ibidem, p.24
[151] Ibidem, p.25.
[152] Ibidem, p.26.
[153] Ibidem, p.27.
[154] Ibidem, p.29.
[155] Ibidem, p.31.
[156] Ibidem, p.38.
[157] Ibidem, pp.43-44.
[158] Ibidem, pp.44.
[159] Ibidem, pp.40-41.
[160] A complete description of Flauti's course, which was grounded on the experience of Fergola's school and include texts from Euclid, Fergola, and Flauti, is provided in appendix to Flauti's *Del metodo in matematiche*, pp.46-67.

Chapter Seven

The Analytic School, or
Mathematics as Universal Language

7.1 Administrative Reforms under the French Government (1806-1815)

Fergola's school had only benefited from the outcome of the ephemeral 1799 Revolution. Things went rather differently when a French Army led by General André Massena occupied the kingdom, in February 1806. The period of the uncontested control of the school over mathematical teaching and research, these "very happy days" in Telesio's words, finally came to an end. The Bourbons, accompanied by Canosa and other loyalist aristocrats, fled to Palermo where, with the support of the British fleet, they organized a network of clandestine resistance against the French. But, this time, the arrival of the French was hardly opposed by Neapolitans: the situation had changed since 1799, and an attempt to renew Ruffo's crusade failed badly. The point is that the blindly reactionary policy of the First Restoration (1799-1806) had failed to satisfy any of the relevant social groups, detaching them further from the Crown. Very schematically, it should be remembered that the aristocracy had been annihilated as a political force; and that the populace of Naples and the peasants of the province, key factors in the 1799 counter-revolutionary campaign, had been disappointed by the first restoration as the revision of the feudal and fiscal systems —promised to the "crusaders"—had not been accomplished. On the other hand, bourgeois landlords and urban middle-classes generally welcomed the French, and they were to be the backbone of the new "modern" state. Around 1803, the intensification of phenomena such as brigandage and liberal-patriotic conspiracies signaled the generalized dissatisfaction; significant was the fact that Massena's entrance into the town was accompanied by a cheering crowd. In March 1806 Joseph Bonaparte, brother of Napoleon, was proclaimed "King of the Two Sicilies", and Neapolitan "citizens" attended the ceremony with enthusiasm. Joseph formed a government composed of French officers and members of illustrious philo-French aristocratic families. A consultative chamber, the *Consiglio di Stato*, was also constituted, where the majority was Neapolitan. The new administration gave space to a number of ex-Jacobins, bourgeois landowners and aristocrats; a group whose common denominator was the reference to the late eighteenth century social and economic reformism. Joseph himself, being a former student at the University of Pisa, shared this philosophical culture. The personality who most characterized the life of the new kingdom was that of Joachim Murat, who was crowned in 1808, as Joseph left Naples to become King of Spain. Joachim, a former cavalry commander and brother-in-law of the emperor, gradually excluded the French elements from both government and administration, and provided the kingdom with an high degree of autonomy from Paris. After 1811 every civil servant had to be a Neapolitan citizen.

The general project of the French kings was an ambitious one. The primary goal was to make the administrative structure similar to that of the Cisalpine Republic (settled in Northern Italy, with Milan as its capital). The task consisted in transforming a highly fragmented feudal society into a centralized administrative state, whose instrument was an efficient and specialized class of civil servants. The French knew where to look for support: the landed middle classes[1]. Wisely, the project was linked to the pre-existing local tradition of reformism, which provided the French with the support of important sectors of culture. In fact, as we have seen, the idea of designing a new political setting, based on the landed middle classes, was a well known element in the teaching of Genovesi's school, and it was also the goal of the 1799 "revolutionaries". The first step towards a general redistribution of wealth was the destruction of the feudal-communal system of land, and its replacement with a "full-property" system. In 1806, this suddenly became a reality. Every town and every land was to be ruled according to the common law; baronial jurisdiction on feudal lands (and relative earnings, as Canosa knew too well) were abolished together with feudal tributes and services[2]. In general, feudal lands were divided between barons (or ecclesiastical orders) and communes, whereas the sale of common lands was supposed to create a consistent class of land-owning peasants. In fact, things went rather differently, as properties tended to concentrate in the hands of a small number of landowners (bourgeois or ex-feudatories), who were able to influence local administrations. As a result, the great properties remained almost untouched, and they were also freed from feudal duties towards to king, and from legal ties such as inalienability. Similarly, few profited from the from the suppression of land-owning monasteries (1807-1809). On the other hand, conditions of life for the peasants worsened, as they lost their rights upon communal land without benefiting from their sale. As for the other reforms, the juridical system was renewed by introducing the Napoleonic civil code and a new penal code. The ancient and privileged Neapolitan tribunals were abolished, and a new network of provincial tribunals was created. The reform of finance was centered on the tax system, which was simplified; work to accomplish a modern cadastre was also started.

Needless to say, these reforms hit very precise and consolidated interests. The barons, the high clergy and the lawyers of the capital, who had been opposing Neapolitan reformism for half a century, were on the forefront of the resistance. The crucial alliance between barons and Neapolitan tribunals against local communities and central government emerged clearly in their common defence of the *ancien régime* institutions. According to the historian de Martino, "it was the forensic order which made the greatest resistance to the diffusion of the reformist culture"[3]. Powerful lawyers and law scholars took the defense of the feudal system as the only "real basis of a monarchy"[4], in a more radical and effective way than barons themselves did. Their attempts to paralyze the new administration were continuous. Such a conflict between executive and juridical power happened at all different levels, down until the opposition between local authorities and justices of the peace. "In fact" de Martino wrote, "even if these contrasts appeared in formal or procedural terms, they hid a precise political value, and important contents for the economical life of the communities, and for the immediate interests involved"[5]. On the other hand, reforms offered new possibilities of social and economical advancement to members of the provincial bourgeoisie. A great number of employees were needed for the new local institutions (both administrative and juridical), and important public works were opened, especially road building, to facilitate internal communication (and the movement of troops). The new bureaucratic machine absorbed Neapolitan "progressive" intellectuals. De Martino remarked:

> The procedures defined by the law in every detail, the clear rules, the guarantees offered to the order of the landowners, the renewed structures of power and, with them, the enlargement of the personnel and the opportunities of accomplishing fast careers founded on merit and not on fortune, as indicated by great part of the eighteenth century literature, created that large social consensus which, in spite of the great difficulties of financial , military and social nature, enabled the achievement of positive results, which will be admitted also by the opponents at the moment of the Restoration.[6]

We will refer to the overall project of reform with the term "modernization". This was clearly centered on the new administrative system which, according to the French constitution "of the year VIII" (when the Consulate replaced the Directoire), was extremely centralized. Its core was the Ministry of the Interior, a new institution which unified different powers, previously entrusted to separate organs (mostly juridical ones, such as the *Tribunale della Sommaria*)[7]. The introduction of this minister was extremely significant, as it derived from the rigorous separation between civil administration (linked to the executive power) and the administration of justice. It was precisely the very active Minister of the Interior Giuseppe Zurlo who was to attract most of the criticisms from the reactionary side.

From 1806, the country was divided into provinces, districts, and communes; the elementary component was the communal council, composed by local landlords and professionals, who expressed the interests of the local community. The province was ruled by an *intendente*, who depended directly on the Minister of the Interior. Through this vertical structure the provincial bourgeoisie could actively participate in the exercise of the political power, even if in the context of a centralized and absolutist system, where civil administration was in fact very much an instrument to control society. Most of the new *intendenti* had taken part in the administration of the 1799 Republic; others were military officers. They had all to face great problems in accomplishing their work. If on the one hand "provincial society, at the beginning of the XIX century had reached a remarkable level of civil development, particularly in certain economically advanced areas", on the other hand brigandage (now supported by the Bourbons), clerical propaganda, and the reluctance of many local administrations to collaborate with the *intendenti* had disruptive effects on the activity the new administration[8]. "In reality" de Martino wrote, "resistance of the peripheral apparatus during the transfer of powers was strong and extended, and it left deep traces in the history of the country"[9]. However, the most urgent reforms were accomplished by 1809. Interestingly enough, in 1808 the government had decided to enlarge the basis of the passive electorate for local administrations: from "landowners" only, to artisans and professionals ("practitioners of the liberal arts"); a move which was aimed to link the government to the economically active groups, and to solve the great problem of the lack of personnel for the new bureaucracy.

Reaction against "modernization" proved to be stronger than expected. As we know, it was not only the interests of barons, lawyers and the Church which were threatened by reforms, but those of many members of the local administrations, and of merchants and financiers who were building their own fortunes precisely on the complex economic system of the country. Recurrent themes of the reactionary propaganda were those of the excessive bureaucratization of the new administration, which was portrayed as detached from the concrete reality of the country, and guided by abstract norms (for instance, equal distribution of land), even in situations which cannot, by their nature, be ruled according to general laws. Abstractness was also seen in the re-definition of the borders of the provinces, which ignored both local history and local traditions. Fierce criticisms were raised against the centralized, "vertical" structure of the new administration, which tended to suffocate local autonomy, and to compromise the autarchic economy of rural communities (presented by reactionaries as examples of perfect social setting). The myth of the "organic" nature of the feudal-communal setting, constituted by the harmonic composition of orders and guilds, emerged vigorously in the early nineteenth century, directly opposed to the "mechanic" and atomized modern society which was described as a mere aggregate of individuals[10]. Finally, the separation between juridical power and executive power, which deprived the barons of their own feudal jurisdictions, and the old tribunals of their administrative role, was said to compromise power, whose nature is essentially indivisible.

7.2. Reforms in Public Education

The new government immediately showed a particular regard for scientific education. As early as June 1806, a "Royal Society to Encourage the Natural and Economic Sciences" was created by Colonel Augusto Ricci, with the goal of "promoting public and private economy, agriculture, arts, wealth, and prosperity in this part of Italy, by means of mathematics, chemistry, natural history, medicine, and veterinary science"[11]. Significantly, the first meeting of the society took place in the palace of the Ministry of the Interior. The most renowned Neapolitan men of science were invited to attend, including Fergola and Cotugno. Fergola, nominated a member in July 1807, refused the offer, allegedly for health reasons. Flauti was called to participate in 1808. The society, renamed "Royal Institute for the Encouragement of the Natural Sciences in Naples" (1810), was charged to give prizes to those citizens whose discoveries had proved useful to improve agriculture, breeding, and manufacturing. The institute published its own periodical (*Journal of Economy and Agriculture*) and its own acts (no traces of memoirs on mathematics, though). The minister of the interior also created the Royal Society of Naples (1808) to replace the old RAS. The society was not very active, as is proved by the fact that the first volume of its acts was published only in 1819, after the Bourbon restoration. This contains important memoirs read by Fergola , Flauti, de Sangro, Giannattasio, and Scorza; the Mathematical Class of the Royal Society was in fact controlled by members of Fergola's school (members in 1811 were: Fergola, Flauti, Sangro, de Ruggiero, Giannattasio and Colonel Vito Piscitelli, director of the fortifications of the kingdom).

An overall reform of public education was begun with the approval of the Organic Decree for Public Education (1811), according to which education was divided into three cycles (primary, secondary, higher), and put under the direct control of the Ministry of the Interior (i.e., very significantly, it was taken away from the Ministry of Ecclesiastic Affairs). Primary schools were created in every town and village, and at least two secondary schools (*collegi* or *licei*) were created in every province, one for boys and one for girls. There were already three thousand free primary schools in 1814. Together with Italian and Latin grammar, pupils were taught arithmetic, good manners, catechism and "practical agriculture"[12]. In 1814 there were also eleven colleges (eight *collegi* and three *licei*), whose teaching was centered on Latin, Greek, Mathematics, and Philosophy. A reform plan for the university was ready as early as October 1806, and was characterized by the reduction of theological chairs (four chairs abolished out of seven, including Texts of Thomas Aquinas), to the advantage of the scientific ones[13]. Among others, the chairs of Rhetoric, Latin Literature, Latin Language, and General History were abolished. A prefect, nominated by the king, administered the university together with a council, an administrator and a secretary (i.e. the Major Chaplain lost his authority over the university). Debates on the structure of the university continued in the following years; in 1808 some chairs were added, and in 1811, with the Organic Decree, the university was reformed again[14]. In the end, one must recognize that the action of the government was not very radical in reforming the university: a generic encouragement to scientific disciplines was offered, leaving in place the old academic establishment, which included powerful professors and their well-entrenched schools. It is also clear that the Royal Society was conceived more as a parade of names then as an effective center of research. The fact is that the French government had decided to bypass rather than radically reform universities and academies; the real instruments of its power were the newly established technical schools, military and civil, whose curricula were designed *ex novo*, in order to suit the needs of a modern administrative monarchy. Consider that a first project of reform of public education, signed by Vincenzo Cuoco, had been rejected by the government in 1809[15]. Now, comparing it with the organic decree of 1811, a main difference emerges: Cuoco had left the teaching of mathematical and physical sciences to the university, charging the new "special schools" with further courses of specialization (not too differently from Flauti's 1820 project); note that Cuoco explicitly manifested his preference for the didactic methods of Fergola's school[16]. The approved project was inspired instead by the system already adopted in the French Empire, with which it shared "the same unity of principles and actions"[17]. According to this system, the curricula of military and civil engineers had to be completely detached from university teaching.

The new government began by reforming the Corps of Military Engineers and the Royal Military Academy, which was re-opened in 1806 under the name of the "Military School"[18]. In 1811 the name changed again to the "Polytechnic and Military School". Reforms were directed by General Jacques Campredon and

General Giuseppe Parisi, the last being the reformer of military education in the 1780s, and a protector of Carlo Lauberg. Courses at the Polytechnic School lasted four years, and mathematical teaching included analytic geometry, descriptive geometry and mechanics; chemistry design and literature were also taught. The goal of the school was twofold: on the one hand to train the officers of the army; on the other to prepare students to enter the more advanced "facultative schools" (where they specialized in one of the following branches: civil engineering, military engineering, artillery, geography, maritime constructions). The direction of the school was entrusted to General Costanzo, who ordered professors to publish their own lectures; as a result, under the collective title *Course of Mathematics*, twelve essays appeared between 1813 and 1815: Arithmetic, Algebra, Plane Geometry, Solid Geometry, Two-Coordinate Analysis, Plane Trigonometry, Three-Coordinate Analysis , Differential and Integral Calculus, Mechanics (I. Static and Dynamics; II. Hydrostatic and Hydrodynamics), Descriptive Geometry, Mathematical Geography[19]. The textbooks of three-coordinate analysis and calculus were written by Ottavio Colecchi, a Dominican monk who cultivated analysis with unusual fervor, and who had been teaching at the Polytechnic School since 1812. Unlike in the older institutions, at the Polytechnic School new teachers were hired who were not linked to Fergola's school, or were explicitly hostile to his geometric conception of mathematics, as in the case of Colecchi, or of a secondary professor of Mechanics, Francesco Tucci. Since 1811 those who explicitly rejected the synthetic approach had concentrated in the newly founded School of Application for the Corps of the Engineers of Bridges and Roads. In its classrooms the purely algebraic conception of mathematics made its triumphal return to Naples, seventeen years after the suppression of Lauberg's private studio.

To be properly accomplished, the French reforms required the constitution of an efficient corps of engineers to realize the essential infrastructures. Without them, a "modern" administration of the country was not even thinkable. First of all, the entire road system needed to be rationalized and increased. To this extent, the minister of the interior created, in November 1808, the Royal Corps of Engineers of Bridges and Roads (*Corpo Reale degli Ingegneri di Ponti e Strade*), possibly the most important institution created during the French occupation[20]. A French General of the Military Engineering Corps, Jacques de Campredon (1761-1837)[21], prepared a plan for the new institution, based on the Napoleonic decree which, in 1804, had reformed the analogous French corps[22]. The plan, approved in 1809, divided the territory into "divisions", each one entrusted to an inspector (3); each division was divided into "departments", entrusted to the chiefs-engineer (6); into each department, the ordinary engineers were responsible for the particular woks (8), and were assisted by the supplementary engineers (6). At the moment of the constitution of the Corps, the 23 engineers were chosen by Campredon (most were civil architects); but it was planned that a specific school should be established to provide well-trained personnel. The School of Application was opened in 1811, and it was to provide, after a four-year course, "aspirant engineers" to be inserted at the lowest level of the rigid hierarchical structure of the Corps. It was also stated that engineers should reside in their department, and that they were under the authority of the *intendente*, which strictly linked their activity to the executive power. In 1814, the School licensed the first class of "aspirant engineers".

Protected and generously financed by the government, the School became almost immediately a serious threat to the prestige of the university (where, previously, civil architects took some courses and their final degree). Professorial wages were superior at the School, and the number of pupils grew decidedly when only the engineers of the Corps were given the qualification of "expert" by Neapolitan tribunals. The School of Application was, from the beginning, a primary center of scientific education and research. As Amodeo remarks, it continued and strengthened the scientific tradition of the Military Academy, and it "had valuable professors, desiring to introduce into Naples those modern analytical studies which, in the university, after Fergola's retirement, were neglected"[23]. Candidates were selected on the basis of an exam which included: arithmetic, geometry, trigonometry, calculus, analytical geometry, design, French, and Latin[24]. Those accepted had to face a curriculum centered on mathematics and its applications. Interestingly, Director Campredon asked the professors to achieve "two main [didactic] goals: 1. instruction depending on what the pupil can perform with his own hands must be preferred to instruction received from lectures and books; 2. the presentation of principles and general methods must be —whenever possible— followed by examples of applications"[25]. Professors should also show clearly the links among different disciplines, and harmoniously integrate the various parts of the curriculum. The innovative didactic methods of the School of Application is worth some comment. It was in many ways analogous to the method of the Swiss Johann Pestalozzi (1746-1827), which had been designed specifically for primary education, and which attributed to the child an active role in the process of education (to the horror of Reactionary Catholics, who considered these schools a source of individualism and rebellion). The philosophical view according to which the essential goal of the sciences is their employment in acting upon empirical reality was reflected in the didactic of the School of Application. It was the continuous verification of the "functioning" of mathematical formalism in technical application with provided it with its sense and justification. The links among disciplines stressed the boundless field of application of mathematics to reality. Machines made their appearance as crucial didactic instruments: in the courses of Physics, Experimental Chemistry and Mineralogy, the two-hour lesson was indeed divided in one hour of lecturing and one hour of "manipulation of machines and repetition of experiments"[26]. Like in Rousseau's *Emile*, to which much of this didactic seems indebted, the student should "not have geographic maps only in his head", but instead he should "know well what is represented, and have a clear idea of the art of constructing [maps]". Interesting examples of the new didactic methodology were, for instance, the course of mechanics, with its integration of theory and application, or the didactic methodology of Luigi Malesci, professor of Civil Architecture. Malesci presented his program in the form of an "analytic table", where the subject is progressively divided into its elementary constituents. Malesci remarked: "all the matters presented in the table can be taught in two years, as it is not necessary to insist on details but rather to show the most general and essential principles", which will be "the basis" for the future works of the students. Malesci wanted to transmit to his students what Padula was to define as "the spirit of the analytic method" [27].

From a later document (1836), we can reconstruct the curriculum of the school. Students admitted to the School entered the "first class", a two year course where "the principal occupation and the great part of the time is dedicated to the mathematical disciplines"[28]. The following courses were given: Architectural Design, Landscape, and Topography; Mechanics and Hydraulics applied to factories, machines, hydraulic works; Descriptive Geometry, and its applications to shadows, perspective, and stone-cutting; Geodesy. Successively, students entered the "second class" a biennium devoted to applications, which included courses in: Applications of Mechanics to Constructions and Machines; *Lavori di terra* (constructions, roads, banks); *Lavori di legname* (roofs, bridges, dikes); Structure of walls and vaults; Masonry bridges, maritime constructions; Architectural machines to move weights, machines to drain; *Lavori di ferro* (in particular, suspended bridges); Art of projecting; Applied chemistry (with laboratory); Agronomy (with laboratory). Among the textbooks: Navier's mechanics, appositely reprinted in Naples; Venturoli's *Elements* (mechanics and hydraulics); and Monge's treatise on descriptive geometry. At the end of the courses, students faced their final exam; those best ranked were offered entry to the Corps of Engineers. Subjects treated in the one-week long final exam were: Mechanics (two problems[29]); Descriptive Geometry (two problems[30]); Applied Mechanics (two problems); Constructions (one problem); Agronomy(one problem[31]); Chemistry (two problems[32]); Architecture (a project, to be completed in the following week[33]).

Carlo Afan de Rivera (1779-1852), Director of the Corps of the Engineers from 1824 to 1852 and the most eminent figure among the supporters of the modernization of the country stated that the School of Application was crucial as for the first time the study of the sciences and considerations of economic policy were closely related. "Our scientists" he wrote, "are afraid of being degraded by getting close to the workshops, and to guide the practice with their theory; so they neglect to apply the sciences to the arts". Instead in his lucid plan of development, which included land restitution, new manufactures, and the construction of new roads and harbors, Rivera concretely showed how much could be achieved by "science applied to the administration of the state"[34].

7.3 Modernization and the Spirit of Analysis

The French interlude provided a concrete opportunity to reform the feudal-communal system of land, as well as the juridical and legislative system. But such reforms could not be implemented in the absence of a corps of well-trained civil servants, administrators, and engineers. Following the French model, it was thought that technical schools devoted to this purpose should include mathematical analysis, as a crucial element of their curricula. This is how, around 1810, a new and influential school of analytic mathematics settled in Naples. Among the new institutional spaces opened by the government for analytic teaching and research was an important journal, which offered space to the economic, political and scientific contributions of many survivors of the 1799 administration. The journal, significantly titled *The Analytic Library* (1810-1823), had a difficult life, as contributors' ideas were often at odds with those of influential members of the traditional academic establishment[35]. Already in 1811, the *Analytic Library* was temporarily closed down, following the pressure of the RAS on the government: in one of the first articles Fergola and his school had been harshly criticized by Ottavio Colecchi. In 1812 the journal re-opened thanks to the support of Matteo Galdi, a former student of Lauberg and an ex-Jacobin himself, who was Minister of Public Education in the French government; publication continued until 1814, under the title *Analytic Library of Education and Public Utility*. Other numbers appeared between 1816 and 1823 when, during the reactionary decade of the 1820s, it was finally forced to close down for good. The tradition of the *Analytic Library* was revived ten years later by a journal titled *The Progress of Sciences and Arts* (1832-1846), which defended the cause of modernization of the country, the School of Application and, more specifically, the cause of analysis against Flauti and the late representatives of Fergola's school, offering remarkable space to Ottavio Colecchi[36].

The spirit of the *Analytic Library* emerged clearly from the essay which opens the first number, titled "Short Philosophical Memoir on the Generation and the Advancement of Sciences and Arts"[37]. The editors began with praising human reason: it will not possibly clear up all of the "darkness which surrounds us", but it will let us know the fundamental principles of reality, and this means that human reason "is much greater than its detractors think"[38]. "Physics" we are told, "was born with the first sensations" of the human being; whereas mathematics makes its appearance only at a rather advanced stage of civilization, as its highly abstract nature makes it less natural to human beings. But yet there is continuity between physics, mathematics and the other sciences; there is nothing like the "essential" opposition between pure mathematics and empirical sciences ("mixed mathematics"), which is crucial to the entire conception of the synthetic school, and which legitimated and shaped its own problem-solving methods. On the contrary, because of this extreme abstractness, mathematics cannot be divided into *pure* and *mixed*. If Mechanics deals with motion, Geometry deals with extension, and Algebra with quantity; so that matter cannot be detached from the most sublime contemplations.[39]

Having read the writings of the synthetics, one can argue that the reference to "contemplation" and materiality had been chosen with a clear target in mind, namely Fergola's school; that there exists a link between contemplative "sublime mathematics" and empirical, material considerations is precisely what Fergola and his students had always denied. The aim of the editors becomes even clearer in the following, where themes from Lauberg and Giordano are echoed:

doesn't every human art tend to let us know the extension, nature and quantity of things? Does Physics have a different goal from Mathematics? And do Politics and the Morals have a different goal? Then, every human investigation contributes to the construction of a Universal Mathematics, and all our knowledge is limited to mathematics. We don't have to be dazzled by the magnificent names which have been improperly given to substances. I see an art which makes me able to determine the quality, the nature, and the quantity of objects, considering them in their more simple aspects.

According to this reconstruction, the individual mind (the great enemy of contemporary theological and political conservatism) produces the "sublime arts" (the higher sciences), by discovering the universal laws out of "naked experience", under the pressure of elementary needs. The knowledge of universal laws of nature is discovered exclusively to be employed to satisfy the material needs of mankind. "The distinction between physical and moral laws, mechanical and animal laws" depends on our considering their "superficial" aspects; essentially, they are simply different manifestations of a the "same, single, universal, irreducible law, which is always variable in its effects, but always uniform in its principles". Lucretius' materialist poem is cited to make clear the point: "Semper motus connectitur omnis / Et vetere exoritur semper novus ordine certo; / Nec declinando facunt primordia motus / Principium quoddam quae fati foedera rumpat"[40]. The quote from Lucretius soon proves to be more than a mere rhetorical ornament, as truths of the moral sciences are explicitly reduced to the theory of motion. Privileged sources are the French *encyclopédistes* and the *ideologists* (d'Alembert and Tracy particularly): a clear connection with the still lively Neapolitan *ideologism* of Delfico, Borrelli and Bozzelli, whose writing enjoyed a remarkable success under the French regime. The cultural framework of the editors of the *Analytic Library* should appear quite clearly once it is added that they described religion as the transformation into "mysterious substances" of what is simply explainable as the action of matter. As we have described the conception of knowledge, science and mathematics of Neapolitan reformers, Jacobins and *ideologists*, we will not insist on the point here. But it is noteworthy how the essential features of this conception returned, under the protection of the French government, in the pages of the *Analytic Library*, in what was a point-to-point confrontation with the dominant philosophical and scientific paradigm. In particular, note the opposition of a methodologically unitary vision of human knowledge to the rigid disciplinary boundaries which characterized the reactionary, teleological system, and the rejection of Fergola's epistemological distinction between pure and applied mathematics.

The first numbers of the *Analytic Library* are an interesting source of material concerning the revival of the "analytic spirit" in Naples around 1810. Thus we find, for instance, the announcements of the Italian translation of the French book *Traité du calcul conjectural, ou art de reasonner sur les choses futures et inconnues*, by Parisot, which made the text available "to readers of every class". The book contained applications of mathematics (probability calculus) to physics, metaphysics, and political economy. Commenting on a book by Jean-Louis Boucharlat, professor at the *Ecole Polytechnique*[41], the editors praised the fecundity of the application of algebra to geometry, and they argued for the reduction of geometry to algebra. A detailed report about the attribution of the "decennial prizes" in Paris in 1809 was published in the second number of the journal[42]. The winner for "Geometry and Analysis" was Lagrange, with his *Theory of Functions*[43], "which provides a solid [algebraic] basis for the calculus", whereas a particular mention went to Sylvestre Lacroix, whose purely analytic textbook of calculus "contributed more than any other to the new direction given to the didactic of the mathematical sciences"[44]. The winner for Philosophy was Jean-François de Saint-Lambert (1716-1803), with an essay (*Catéchisme universel*) where he argued for the possibility of reducing the principles of morals to the natural constitution of the human being, and claimed that morals themselves have to be the object of a proper science. The overall impression given by the memoirs of the *Analytic Library* is well captured by one of its many anonymous contributors, who wrote: "everything announces the near fall of the Republic of Letters, and the universal monarchy of the exact and natural sciences".

The new series of the *Analytic Library* (now *Analytic Library of Education and Public Utility*) edited under the protection of Matteo Galdi, was opened by another very interesting epistemological essay on the "advancements of human spirit"[45]. The general assumption was that "all ideas are linked to each other, so that human knowledge appears as a single object, the only variable depending on the point of view from which it is considered"[46]. The knowledge of the physicist, the mathematician, the ideologist, the moralist, the legislator, and the physiologist support and enlighten each other, in a way which does not present a stable hierarchical order. Relations among different branches of knowledge are presented by an analysis of "modes", "means" and "objects" of human knowledge. As for the "modes", we read that human knowledge is not obtained through a "rude" and "passive" empiricism, but through experience plus reason, as it has been shown by the "philosophy of experience", which "frees man from the chains of empiricism, and provides him with deduction and the method of generalization"[47]. Models, to this extent, are Epicurus, Locke and Kant (the editors seem to know Kant's philosophy mainly through French translations). As for the "means" to acquire knowledge, we read that all human faculties have to be contemporaneously employed. The segregation of faculties and their specific use to acquire specific knowledge, i.e. the basis of the Reactionary Catholic system of knowledge, and the theoretical justification for apologetic empiricism, are decidedly rejected. Senses and imagination have to mix in order to produce good science. "Philosophy", we are told, "must not limit itself to the spectacle of nature, and to the dry enumeration of the parts which compound it; all its efforts are fruitless if for each phenomenon one does not look for its productive causes". "Let us concede human genius the right to freely proceed then", and if the mathematician must certainly contemplate "intellectual truths", he should not disregard "the illusions of imagination", as "only the concurrency of all the faculties of human spirit provide us with the complete means of knowledge". As for the objects of knowledge, we read that "philosophy is the science of the principles of the relations among things", and looking for a *philosophia prima*, i.e. an aggregate of indubitable, absolutely certain principles, "will always be an erroneous direction to take"[48]. Note that, in some previous remarks, the possibility of reconstructing a body of original pre-Greek knowledge (i.e. the Christian *philosophia perennis*) had been decidedly ruled out on historiographic grounds[49]. One can only talk of first philosophy referring to the "analysis of our cognitive means", which is accomplished by following the *ideological* schemes of Tracy and Cabanis, and by introducing Kant's criticism. Tracy's division of philosophy into ideology, grammar, and logic is adopted, with ideology being the study of our sensible perceptions and the "foundation of every other science", as every intellectual function is a mere "function" of perception; the relation between the moral and the physical spheres is strict, and its modality is that presented by Cabanis[50]. Grammar is the study of human systems of signs: "artificial signs are necessary to the formation of most of our ideas" the editors argue, so that through grammar one can investigate the very processes of generation of our ideas. Logic studies "the procedures of our intelligence", after the fashion of Locke, Condillac, and the *ideologists*. The traditional view where logic is "the mere art of deducing consequences from otherwise known principles", is replaced by the new field of transcendental studies[51].

A description of the more recent results in every branch of knowledge is then offered, with the explicit intent of showing "how everything is related to everything else in the system of human knowledge, so that pieces of knowledge which seem very different can take reciprocal advantage from enlightening each other"[52]. Morals are not grounded on a divine revelation, but instead on truly universal principles grounded in the eternal nature of human beings (Filangieri and Pagano are cited); its laws emanated from individual human reason, and are related to the "organization" of our being (our needs, our feelings). Economics "depends entirely on morals"[53]; "it has been argued that administrators only need good-sense and matter-of-fact knowledge" (think of the reactionary literature), "but what is this good sense, after all?" and "what are facts without connections?"; the old view was simply meant to charge "a restricted number of people" with the administration of the state[54]. In reality, "economic truths" are "necessary consequences of the nature of things", and as such they are knowable by everybody. The link with Neapolitan reformism is evident and the names of Genovesi, Caracciolo, Grimaldi, Palmieri, and Delfico are explicitly mentioned. Their common goal was to transform economy from "an aggregate of empirical observations" into a "science" characterised by "connections between ideas, universal principles, and certain deductions"[55]. The science of legislation has to be equally based on human nature, and it should be designed as a single, general and abstract set of norms, banning the various ancient legislative systems. Much space is devoted to the physical sciences, which include natural sciences as well as those branches, like astronomy and mechanics, where in these days "the solution of problems depends more on the perfection of analysis than on the exactness of observation"[56]. Laplace's *Mechanique Celeste* and Lagrange's mechanics are taken as paradigms in this area of knowledge. Quoting Laplace, the editors argued for the necessity to integrate empirical observation with the efforts of the human imagination ("the flights of human reason" Flauti would say): the mere collection of facts would produce a "sterile nomenclature", not a science. It is "higher mathematics" applied to "the results of experience that can perfect the work of physics by expressing through calculus the universal laws of nature"[57]. Analysis is not an imperfect, artificial, external apparatus which can "cover" nature, but the only instrument to capture with precision the true universal laws. The two-hundred page essay ended up by reporting the latest achievements of analysis. Geometry was defined as "an entirely human creation", and a Kantian account was provided for the certainty of its truths, mixed with an *ideological* reconstruction of the processes through which we obtain the idea of "extension" out of experience. "As a consequence" the editors say, "preference should be certainly given to analytic methods, and the excellence of the method of projections should be recognized by everyone". And indeed, "how easy the task in coordinate geometry is!" Application of algebra to the theory of curves is "one of the most fruitful connections ever made in science"[58]. As for the calculus, it has finally found its sound foundations in algebra, thanks to Lagrange, so that its rigour is now "not inferior to that of the ancient demonstrations"[59]. The science of calculus is certain and "applies to everything"; the "languages" that it uses are "useful scientific instruments"; and ultimately, it is part of that "universal grammar, which provides it —as any other part of our knowledge— with its own certainty". Those who claim that the new methods are uncertain are not only wrong, but they are also "hindering the progress of science"[60]. It was very much a revival of late eighteenth century sensationalist *ideology*, with the insertion of themes from Kantian criticism. Kant could indeed be used to complete and improve the transcendental analysis of human understanding which had interested Genovesi and the French and Neapolitan *ideologists*. In such a theoretical framework, Neapolitan intellectuals supporting the modernization of the country could, once again, group together and exercise their pressure on a well-disposed government.

7.4 Ottavio Colecchi: Analysis, Kant and Liberalism

Colecchi's 1810 memoir in the *Analytic Library* showed once again to the Neapolitan public the subversive potential of mathematics. For the first time since 1794, mathematics as practiced in Fergola's school was openly criticized. The attack hit – at once– a problem-solving method, a conception of mathematics, a conception of knowledge, and the hierarchical relation between religion and science. The memoir earned Colecchi a secondary chair at the Polytechnic School, but also the hate of the synthetics and a number of enemies, particularly among the ecclesiastics, who were to take their revenge at the return of the Bourbon.

Colecchi was born in the province of Abruzzi in 1773, and in 1794 he had entered the Dominican order. He obtained a doctorate in theology, and only afterwards devoted himself to mathematics and philosophy. In 1809, as monastic orders were suppressed, Colecchi became a secular priest, but he possibly kept on wearing his black and white Dominican frock, as this is how he was portrayed later in his life. By 1809 Colecchi was "a very famous predicant", and he had already given proofs of his temperament, as we are informed that in 1807 his cell had been searched for hidden weapons[61]. In 1810 Colecchi was in Naples, where an abstract of a Latin work of his on *vis viva* appeared, and an essay on fractional functions (both in the *Analytic Library*). The essay contained an explicit attack against recent works of Fergola's school, and particularly Fergola's memoir on fractional functions. Colecchi seemed to be well informed about recent developments in infinitesimal calculus in Northern Italy and France, and he accused the synthetic school of hardly making any original contribution to the field. Telesio himself tells us that the very publication of the 1811 synthetic collection was accomplished in response to increasing criticisms, in order to prove that modern analysis was not unknown in Fergola's school. Now, Colecchi was saying that the collection had only made things worse for the synthetics and for their famous maestro. A passage is worth quoting in its entirety:

> I fear that Euclid, with his great power, could cause mathematics the same damage Aristotle caused to philosophy. I agree that we must respect the father of geometry, and every other ancient geometer; but the exaggerated deference to synthesis, the servile attachment to the ancient constructions can indeed damage the progress of these sciences. In fact, it seems that the damage is becoming evident: while in France Laplace writes the *Mecanique Céléste* and the *Exposition du Systéme du Monde*; Monge writes the *Geometrie Descriptive* and the *Analise Geometrique*; Puissant writes the *Geodesie* and the *Recueil de diverses propositions* where, by means of the method of coordinates, he solves the hardest problems with a simplicity and an elegance without comparison; while in France and in Northern Italy these and other valuable men write such immortal works, here in Naples one discusses about the "problems of contacts", and a new property of the triangle; or about the method of inscribing a triangle in a circle whose sides pass through three given points; and one writes with didactic rigor a memoir on fractional functions and their reduction to partial functions, enriching these and other similar jokes with scholia and notes.

Colecchi continued declaring that he was looking forward to the publication of the *Heuristic Art* of Fergola's, as this work "will let the foreign countries know that even in Naples mathematics is cultivated, repairing the unfavorable impression which could be given by the already published works, which never exceeded mediocrity". Colecchi's ironical remarks were welcomed by the editors of the journal, who encouraged him to continue his research, showing that mathematics was profitably studied even "far from the capital". In 1811 Colecchi was invited to join the new *Società Pontaniana*, where he read a memoir on the principle of minimal action. In 1812 Colecchi published a second mathematical memoir in the *Analytic Library*[62], and he became secondary professor of Sublime Calculus at the Polytechnic School; note that this topic had been previously taught to military officers by members of Fergola's school. Colecchi declared that he used to teach calculus "with the new method of the analytic functions"[63]. In 1814 his textbooks of analytic geometry and differential and integral calculus were published by the Polytechnic School.

With Colecchi's teaching, made possible by the editors of the *Analytic Library*, the Neapolitan analytic school was born to its difficult life. Links with the previous analytic tradition of the 1790s were many, and not only at the level of ideas. So, for instance, directing the Topographical Office —which was related to the Corps of

Engineers, we find Ferdinando Visconti (1772-1845), a former Jacobin conspirator who had studied mathematics with Annibale Giordano. He, like many other ex-Jacobins, had re-entered Naples in 1806, to be offered a place in the French administration. And with ex-Jacobins came French and North Italian analytic textbooks: the "invasion" denounced by Flauti. To the eyes of Fergola's pupils it was no time for compromise, and the strongest resistance was organized. It is again Telesio who tells us about the episode of a North Italian professor who reached Naples in 1807 hoping to get a place from the French government, as he was a convinced analytic. He visited Fergola's school, where he was offered a demonstration of the "Greek-like" ability by the pupils, in a contest which seems to be a prelude to the *disfida* of 1839[64]. In its own way, this apologetic narration tell us something important: the school, after a decade of easy life felt attacked by the educational policy of the new government, by the new foreign textbooks that now freely entered the kingdom, and by "strangers", who took posts away from the pupils of the once omnipotent Fergola. Indeed, the reform of public education directed by the former Jacobin Matteo Galdi was following the theoretical indications provided by authors such as abbé Cestari. If this program had been completed, mathematics as taught by the synthetics would be pushed out of public institutions. Murat's suicidal campaign in Northern Italy, and his summary execution by a Bourbon platoon (1815) prevented this from being the case.

Let us continue to follow Colecchi through this complex period of Neapolitan history. In 1816 he asked for a promotion to a primary chair, but this was refused by the restored Bourbon government. Disappointed, Collecchi left his post that very year and went to Rome, accepting the invitation of the Dominican order to teach theology at their college. Through the Dominican order Colecchi then went to Saint Petersburg, where he taught philosophy and tutored the children of Tzar Nicholas I. In 1818 his name was among those of the members of the Imperial Academy of Sciences of Saint Petersburg. Colecchi was back in the kingdom in 1819, employed as professor at the Royal College of Aquila, in Abruzzo. We already know about the reactionary turn which followed the constitutional government of 1820-21; Colecchi was one of its many victims. In fact he was not suspected (as some biographers seem to believe) of directly participating in the liberal insurrection; his dismissal was rather based on "philosophical" reasons. The intransigent bishop of Aquila and the provincial *intendente* —Canosa in person— considered his teaching dangerous for public order: "Colecchi" reported the bishop to the special tribunal in Naples, "has shown a decided inclination for the pestiferous and abominable philosophy of Gante [Kant], which is subversive of all morals". Canosa reported that Colecchi had on one occasion spoken so "to offend the decency and the purity of morals", and that "the one who diffuses such free principles in religious matters is not apprprpiate to teach the youth"[65]. Colecchi was fired, and for a while he taught privately in the province. Only in 1831 was he authorized to teach mathematics in Naples at a private studio. In 1833 his name was among the candidates for a chair of Descriptive Geometry at the Military School; but Reactionary Catholics being still politically strong at that time, and Francesco Colangelo being minister of education, his possibilities of success were low: indeed the old accusation of atheism was remembered, and his application rejected. On that occasion, Colangelo substantiated his report by attributing to Colecchi the claim that the existence of God could not be proved, neither a priori nor through the contemplation of nature. To the bishop and to the police this meant that, even without being a liberal conspirator (*carbonaro*), Colecchi "thought as such". His way of thinking was judged "deranged and perilous", contrary to reason and "to the arguments of the apologists of the Christian revelation". This "monstrous absurdity" defended by Colecchi confirmed suspicions about his "incredulity" and made him "very pernicious to the youth, particularly in a military institution". His "irreligious thought" and his arguing for "liberal principles" was confirmed again by the bishop of Aquila, self-proclaimed defender of "religion and the throne". Colecchi was relegated to the margin of scientific life because of his "immorality" and alleged atheism, which were linked to his Kantianism. In fact Colecchi had been a sensationalist, follower of Locke and Condillac until around 1818. During his travels back from Russia, he had sojourned in Germany where he could study Kant's original works: he was among the first Italians to read Kant in German and to master Kantian criticism. His monstrous error was, essentially, the same as the philosopher-reformers and of the Jacobin intellectuals: the secularization of knowledge, and the adoption of methodological individualism. During the 1830s Colecchi, strictly controlled by Bourbon police[66], wrote much of his philosophical work, and some other mathematical memoirs. In 1843 he collected these essays in a three-volume book, but the publication was interrupted by the intervention of censorship. Probably dating from this period there are a couple of anonymous satirical sonnets where Colecchi is defined as a "haughty mathematician", an "apostate", "ambitious", and as atheist as Epicurus and Rousseau. One sonnet concluded: "where is your science? / Where is that necessary basis of honor and piety?/ There is no knowledge in this world without God!"[67].

The accusation of atheism raised against Colecchi in 1821, in 1833, and again in 1843 —when the publication of his major work was interrupted by religious authority, has been presented by historians as a calumny launched by his "enemies" (i.e. exponents of Reactionary Catholic clergy). In support of this "minimalist" interpretation, material attesting Colecchi's faith has been also provided. The point is that one can certainly believe in the sincerity of Colecchi's faith without accepting such a superficial reconstruction of this important episode. If the accusation of atheism was possibly false, the reasons for the conflict between the Christianity of Colecchi and that defended by Reactionary Catholics were instead very real and deep ones. It was not a question of a single episode, but of the entire philosophical and scientific activity of Colecchi. Colecchi was, since 1810, the most representative exponent of the analytic approach to mathematics in Naples, well-known also outside the restricted mathematical community. His authority among young students of philosophy made him most dangerous to those who opposed his ideas. In the first phase of his career, the most "mathematical" one, Colecchi defended analysis against Fergola and his school; the philosophical grounds of this defense were philosophical sensationalism, *ideology* and the belief that human reason is self-sufficient to make sense of empirical reality, i.e. to discover the true laws of nature and to provide rational laws for society. Like abbé Cestari and the Jacobin priests before him, Colecchi never rejected his faith, but he rigidly separated the sphere of personal religious belief from that of objective knowledge, where individual reason is sovereign. In the end, Colecchi's mathematical practice and his political liberalism were both founded on one and the same philosophical perspective, which he shared with the editors of the *Analytic Library*. Now, I suggest that also Colecchi's interest in Kantian criticism can be explained by referring to the same unitary perspective: criticism provided him with powerful intellectual resources to strengthen his own views on the role of human reason in the construction of knowledge and society. More precisely, criticism provided Colecchi with what seemed to be more effective arguments to support the thesis of the autonomy and self-sufficiency of reason, replacing the old-fashioned (in the 1830s) *ideological* analysis of human understanding. The Neapolitan philosopher Colecchi attacked in his writing was the anti-Kantian Pasquale Galluppi (1770-1846)[68], a *protegé* of the ultra-conservative politician Giuseppe Ceva Grimaldi; significantly, Galluppi was preferred to Colecchi for a chair in philosophy at the RUN. Galluppi in philosophy and Fergola's school in mathematics: with such enemies, no wonder that Colecchi's academic life was all but simple.

The philosophical-theological interpretation of the attacks against Colecchi is also supported by the contents of an essay which appeared in 1844, in a periodical entitled *Science and faith* (*Religious, scientific, literary and artistic collection, which shows how human knowledge supports Catholic religion*). The periodical, founded in 1841 by the ecclesiastic Gaetano Sanseverino (1811-1865)[69], was the official expression of the new-born Neapolitan Neo-Scholasticism, and the first periodical of its kind in Italy[70]. Contributions concentrated on the crucial topic of current theological debate: the relations between individual reason, revealed religion and the structure of society. The goal of the periodical was to continue, with renewed intellectual resources, the anti-modern campaign of early Reactionary Catholicism. As the publication of Colecchi's complete philosophical works was interrupted, the editors of *Science and faith* pointed out his "metaphysical and moral" errors to their public. They replied in this way to "those journals" (i.e. *The progress*) which had "greatly praised" the first two volumes of the work, and had suggest its reading "to the educated youth"[71]. The editors did not delve into Colecchi's version of Kantianism[72]; instead they remarked —correctly— that the basics of Kant's theory of knowledge were fully accepted by Colecchi, so that he concluded that every sound science must be grounded on synthetic a priori judgements. This, they said, is precisely what "our illustrious fellow-citizen Galluppi [...] has always fought [...] making it impossible for Kantianism to consolidate its positions in Italy" (Galluppi is defined as "a philosopher dear to every sincere Catholic")[73]. The editors note that, according to Colecchi, the notions of space, time, substance, and cause are not obtained from experience as "they are proper to the thinking subject", and that they are sufficient (Colecchi rejected Kantian categories) for the synthesis of sensible intuitions. Furthermore, the three "absolute ideas" of myself, world and God are introduced as a need of reason itself, something it admits in order to build its system of knowledge, but they have no reality apart from that. The editors recognized in Colecchi the same fundamental error they had already discovered in Kant: according to his theory of knowledge individual reason is autonomous and self-sufficient in its construction of the entire edifice of knowledge; it is the ground of natural laws as it is the ground of moral laws, so that "moral laws do not depend on God, but instead the existence of God is deduced by the existence of moral laws"; God himself is a concept, an "idea" without any real referent. And about the soul, one cannot know anything about its immateriality and immortality. In fact, Colecchi defined human reason as "autonomous and legislative"[74]. Particular attention is given to the conception of moral laws, as Colecchi sees them followed spontaneously by human beings, whereas the editors stressed that they are essentially "commands". These are seen as "most grave and fatal errors", common in different ways to "German rationalists" *à la* Kant and to "French progressionists"[75]. According to the editors, Colecchi had proved to be an enemy of the "restoration of Italian and Catholic philosophy", and he was most dangerous because "he is so renowned, which makes us fear that his errors are very detrimental for studious youth". Backed by Reactionary Catholic clergy, by the time of the attack on Colecchi, Sanseverino had successfully transformed the Thomistic theory of knowledge in the official response of Neapolitan Church to secularized scientific knowledge. In 1846 Sanseverino founded the Academy of Thomistic Philosophy; he also began to teach Logic and Metaphysics at the Archiepiscopal College. Meanwhile, in 1839, the old Archiepiscopal Academy had re-opened under the aegis of the Scholastic methodology. Here we see a Neo-Scholasticism flourishing which was to have important consequence on Catholic culture world-wide. The cultural and political implications of this early Neo-Scholasticism are clear enough; let us just note that Sanseverino wrote to defend the thesis that "the relation of the sovereign with his subjects are similar to the relations of God with the world, and of soul with the body"[76]. The weakness of individual reason was weakness in front of God, in front of political authority, in front of nature; political dissent and pro-constitutional manifestations were no more legitimate than the moral "monstrosities" of Kantianism, or the imaginary constructions of the haughty analytic mathematician.

We can now conclude our remarks on Colecchi. Between 1836 and 1840 Colecchi published eleven memoirs in *The progress*. He treated the philosophical question of analysis and synthesis (in a Kantian framework), the "laws of thought", the process of mathematical induction, the moral laws, the philosophy of Victor Cousin, and the mathematical question of the properties of a certain geometrical surface (which he investigated through descriptive geometry). Through the use of Kantian transcendentalism Colecchi had dissolved the opposition of analysis and synthesis as it had been presented by the synthetic school. Interestingly, Colecchi also argued that the principle of mathematical induction was as a safe and rigorous way to reach mathematical truths (it yields "necessary consequences", like any other principle employed in mathematical proofs), so that it can be used in analytic research[77]. Meanwhile, Colecchi did not conceal his inclination for liberal ideas, and it was a fact that many among his students were implicated in political trials before and after the upheaval of 1848. His visits to the political prisoners at the fortress of Castelnuovo were later described as crucial to the morale of Neapolitan liberals[78]. Colecchi died in 1847, and his funeral was the occasion for a political demonstration of liberal students.

7.5 Other Members of the Analytic School

Colecchi was not alone in his battle. On the philosophical side he was soon joined by liberally-oriented students of German transcendentalism (Hegel was rapidly becoming popular in Naples); in mathematics his analytic views were brought to success by the engineer-mathematicians of the special schools. Among the early well-known analytically inclined teachers were Salvatore de Angelis (1789-1850) and Francesco Paolo Tucci (1790-1875). They both taught at the School of Application, and they also ran a private studio of mathematics, which attracted around two-hundred students in the 1820s, and which can be considered the core of the analytic school. The studio "employed books and ideas arriving from abroad, and it followed the new scientific methods, leaving the ancient forms to embrace the modern ones, so that it was the antithesis of the school of Flauti, Giannattasio, and Scorza"[79]. I have not found any printed works by Angelis, but his didactic ability was highly regarded among the following generations of engineers-mathematicians. He taught at the Military School from 1815 and, in 1819, he began to teach also at the School of Application (Applied Mathematics, using as textbook the analytic mechanics by Venturoli). He was member of the *Accademia Pontaniana* and, later, he entered the RAS. He edited and wrote the notes for an edition of the *Algebra* by Lacroix, a textbook favored by analytics. More is known about the work of Tucci, who had been studying at Fergola's private studio between 1808 and 1811. Amodeo made an interesting remark on the young Tucci:

> The strong group of Fergola's pupils, led by Flauti, that is to say the *synthetics*, never mentioned Tucci as one of them, but we have found evidence of his attending Fergola's evening meetings, together with Flauti, Scorza and others. Thus, we can conclude that, more than other of Fergola's pupils, he was induced by his temperament to leave synthesis for modern analysis; as early as 1812 he had indeed manifested his inclination for Lagrange's analytic geometry.[80]

This episode, which reminds us of Giordano's "betrayal" in 1790, can possibly help us to make sense of two memoirs Tucci published in 1812, which seem to point in opposite directions. One was a synthetic solution for a problem which Lagrange thought was very difficult to solve through pure geometry, and it was addressed to "the estimators of the geometry of the ancients"[81]. In the second, Tucci chose a classical locus problem —that of the four spheres— which since Montucla had been defined as one where the application of modern analysis was particularly difficult, and solved it *à la* Lagrange[82]. Tucci offered a solution "deduced from the basic principles of the method of the coordinates", which permitted a "complete examination" of all the possible cases and the extension of the solution to analogous cases such as that of three circles. In 1812 Tucci also read a synthetic memoir at the *Società Pontaniana*, where he provided a solution to some problems relative to conic curves and to the surfaces originated by their rotation[83]. In this memoir, he showed he was able to master the techniques of geometrical analysis, as should be expected from a pupil of Fergola, but at the same time he accomplished a very subtle apology for algebraic analytic methods, as he provided in footnotes the relative analytic solutions, which are said to be simpler and very general (applicable to any kind of curve); so that the reader is forced to conclude that the analysis of the ancients can be an interesting and beautiful exercise whose result are, nevertheless, very limited. And when it came to provide solutions for the different possible cases, Tucci chose only a few of them, because to provide a complete solution would mean "to solve ten different problems". In his conclusion Tucci noted that "to complete the theory of the planes tangent to the surfaces generated by the rotation of conic curves around their primary axes" a certain very general problem should be solved, but this would be impossible to solve according to the methods of the ancients as its degree is superior to the fourth (whereas an analytic solution is presented in footnote).

The publications and the memoir enabled Tucci to received his first appointments by the French government in 1813. They were at the Polytechnic School and at the Military School (of which he was later to become director). In 1818 Tucci published an essay entitled "The problems of the circle and the three points solved with analytic method and generalized to the other conic curves"; it was, once again, the old problem of Cramer. After the brilliant synthetic solution provided by Giordano, the problem had been treated by other members of Fergola's school and by the French Carnot and Luhilier. In 1810 a very simple analytic solution had been presented by Gergonne in the first volume of his *Annales des Mathematiques*, and six years later he generalized it to the case of the parabola. In 1817 Poncelet replied that analysis could not provide solutions whose elegance and simplicity was superior to those provided by purely geometrical methods, giving rise to an intense controversy over geometrical methods in France which presented many analogies with the Neapolitan one. Poncelet defended the use of geometrical methods which never lose of sight the particular figure; whereas Gergonne praised the generality of solutions provided by purely analytic methods. The exchanges of the French debate were read with interest in Naples[84]; and Tucci's essay of 1818 was indeed a version of Gergonne's solution to the problem of Cramer.

In 1823 Tucci published an memoir where he analytically solved a problem concerning triangular pyramids whose ancient synthetic solution had been recently "divinised" by Scorza[85]. In this piece, dedicated to the students of the Military School and of the School of Application, Tucci argued that the elegance of algebraic reasoning was not inferior to that of synthetic reasoning. In 1823 Tucci also read an important analytic memoir at the RAS, but it was not selected for publication in the acts of the academy (monopolized by Flauti and his colleagues), and it was eventually published as an independent opuscule in 1825[86]. In 1832 he published a major work on the properties of spiral surfaces, whose practical applications were relevant in architecture[87]. In 1843 Tucci published his course of differential and integral calculus given at the Military School, which seems to follow the lectures by Claude Navier (1785-1836)[88]; in the same year he was finally admitted at RAS, where he replaced Scorza, who had died. At the RAS he presented a number of analytic memoirs, often in response to questions raised by analytic mathematicians from Northern Italy; and in 1846 he edited the translation of the *Treatise of Descriptive Geometry* by Charles Leroy (1780-1854)[89]. In 1855 Tucci became professor at the University of Naples, where he continued his activity well beyond the fall of the kingdom.

In the 1820s, the course of mathematics offered at the private studio of de Angelis and Tucci lasted three years. During the first year students were taught Plane and Solid Geometry, Arithmetic, and Algebra (up to second degree equations) by de Angelis; in the second year they studied Complements of Algebra, Calculus (Tucci), Trigonometry, Two and Three Coordinate Analysis, (de Angelis). The last year was devoted to applied mathematics, and main subjects were Mechanics (de Angelis), Complements of Calculus, Descriptive Geometry (Tucci). De Angelis offered a complementary course in Hydraulics, using the analytic textbook by Venturoli; other textbooks used at the studio were the arithmetic by Amante; the geometry by Legendre; the analytic geometry, algebra and calculus by Lacroix, which was later replaced with the calculus by Navier and finally by that of Tucci; the mechanics by Venturoli, and the descriptive geometry by Leroy. About one hundred students entered the first class every year (against around thirty entering Fergola's studio); among them were Fortunato Padula and Giuseppe Battaglini, who studied at the studio to prepare for the examination of admission to the School of Application. After the death of Angelis, Battaglini taught at the studio; meanwhile other studios were strengthening the analytic tradition, with such young teachers as Padula and d'Andrea. Interestingly Amodeo remarked that these studios, centering their teaching on calculus, mechanics, and applied mathematics damaged the progress of mathematics in Naples, as "they prevented great minds from applying to higher studies", i.e. pure mathematics[90].

In addition to the School of Application and to the private studios, the Military School was a center of diffusion of the analytic approach. Tucci was director of the institute during the last years of the Kingdom, whereas Padula taught Rational Mechanics. Teachers from the college played an active role during the 1848 liberal insurrection and in the ranks of the constitutional government, so that they were expelled by the Bourbons in 1849. Among them were interesting figures of liberal and patriotic mathematicians such as Carlo d'Andrea (1802-1885), who had been privately teaching Superior Algebra since 1827, and had a chair at the School of Application since 1829 (Hydraulic Architecture, then Applied Mechanics). Andrea published his lectures of mechanics and theory of machines (1836), and textbooks of arithmetic and algebra. Also expelled in 1849 was Carlo Rocco, who wrote a textbook of geometry (*Catechismo di matematiche*) whose interesting historical introduction presents the works of Maurolico, Desargues, Pascal, Borrelli, noting what was "modern" in them, and claiming that the superstitious respect for the ancients was retarding the progress of mathematics. Mathematicians like Andrea and Rocco, professors in the technical schools, teaching applied mathematics, sustaining liberal ideas in politics, and favorable to the process of unification of the Italian nation under a constitutional monarchy, were the indeed typical figures of supporters of the analytic trend. Also suspended was Ernesto Capocci (1798-1864), "fierce political antagonist of Flauti"[91], and Director of the Astronomical Observatory of Naples, who had hosted in his house meetings of Neapolitan liberals. His assistants Antonio Nobile (1794-1863) and Giuseppe Battaglini (1826-1894) were also suspended. They were all re-instated and given posts at the university after the fall of the Bourbon monarchy. Among those of the "third generation of analytics" were many former pupils of Padula: Vincenzo Janni (1819-1891), professor of algebra at the Naval Academy from 1844 and patriot fighter during 1848; Camillo Zocchi (1817-1850) engineer and translator of Legendre's geometry and Lacroix's trigonometry (1841 and 1840 respectively); and Raffaele Rubini (1817-1890), who had studied at the School of Application and was teaching calculus and mathematical physics in the Royal College of Lecce when, in 1849, he was fired for political reasons. In 1851 Rubini wrote a textbook of analytic geometry dedicated to his maestro Padula and, in 1861 with the fall of the Bourbons, he was called to teach mechanics at the university, and he was charged with writing new textbooks for the secondary schools, as the monopoly of Flauti's books had been finally abolished. Lastly, let us consider the case of Achille Sannia (1822-1892), pupil of Angelis and Tucci and engineer of the Corp of Bridges and Roads. He perfected his mathematical studies with Andrea, and in 1853 he was teaching three-coordinate geometry at the School of Application; in 1856 he opened a successful private studio (subjects taught were: arithmetic, algebra, trigonometry, analytic geometry at two and three coordinate, infinitesimal calculus, descriptive geometry, and rational mechanics). He was known to the police since 1848 as a "republican, and one able to harangue the people"; and indeed he conspired in favor of the unification of the kingdom to the Italian state. After 1860 he was responsible for public education in Naples, director of the School of Application (1863), and was an eminent Italian mathematician for twenty years.

7.6 The Engineer and his Enemies: Ideology of Progress *versus* Conservative Utopia

Like other contemporary cultural and artistic phenomena, the controversy over geometrical methods can be properly understood only against the background of the momentous social process which we called the "modernization" of the country. Such a process, which had been suddenly accelerated by the administrative reforms of the French government, continued under the restored Bourbons, in spite of the resistance offered by important sectors of Neapolitan society. The 1820s and 1830s saw an intense clash between the party of the moderns and a fierce conservative reaction. By the 1840s, the political relevance of the Reactionary Catholic option had definitely faded, as had certain other cultural phenomena which had accompanied its rise, such as the synthetic school of geometry or the School of Posillipo, an artistic movement which had renewed landscape painting in Naples.

In 1815, the restoration of the Bourbons maintained much of the centralized structure of the state, as it suited the absolutist ambitions of the Crown. Furthermore, from Vienna there were clear indications about the necessity of maintaining at their place most of the personnel of the French administration. Prime

Minister Luigi de' Medici was the symbol of the so-called "politica dell'amalgama" (1815-1820), contested by Canosa and his ultra-reactionary fellows. However there were institutions which were so intrinsically representative of the French spirit which could not remain untouched: first of all the School of Application and the Polytechnic School. The Corps of Bridges and Roads and its School were both abolished in 1817, to be replaced by a General Directory of Bridges and Roads (with no school annexed), which largely restored the pre-1806 situation[92]. The new institution was characterized by the suppression of the professional figure of the inspector, by a drastic reduction of the personnel (from sixty-nine engineers to fifteen), and by the precarious juridical condition of the engineer —as civil engineers could be employed with short-term contracts, with no guarantees about the continuity of their job. The function of the Corps was reduced to that of controlling single public works, the administration of funds and the general control being appointed to the Provincial Deputations for Public Works. The Bourbon reforms hit the autonomy and the efficiency of the Body; they also diminished the distinctive expertise of its members by eliminating the School and employing external elements with temporary contracts. Note also that the real decisions were not taken any more by the Corps and the Minister of Interior, but by the "provincial deputation", which was an expression of the interests of local elites. The Corps was in fact the battlefield for the fight between the supporters of a strong central government and those of the intermediate bodies. No figure was more representative of the central government than the engineer of bridges and roads, who planned new public works without considering the opinion of local authorities. Around 1817, after years of centralizing action, the pendulum had shifted in favor of local elites, slowing down the entire process of modernization. In the Bourbon plans the Direction should be a flexible instrument to solve different problems one after the other, depending on the contingent financial situation, the idea of a unifying plan of public works for the entire kingdom being put aside. "The omnipresent role assigned to the director" it has been remarked, "would have hardly promoted a dynamic and active program"[93].

Already in 1818 it was evident that a School of Application was in fact needed. The new institution differed from the previous one by its elite character, the payment of a monthly fee being introduced. Furthermore, the economic treatment of the engineers had worsened and their social position was markedly diminished. Under the French, the figure of the engineer had been attributed social prestige and economical benefits, so that "the engineer had become, even in the south [of Italy], an official whose dignity was equal to that of the officials with a traditional rhetorical-juridical culture, and his job assumed a stable nature and a primary relevance for the national interests"[94]. Conversely, the Bourbon administration tended to undermine the authority and the autonomy of these "technicians".

The necessity to return to the original autonomy and professionalism of the Corps was upheld with energy by Carlo Afàn de Rivera, who became Director of the Corps in 1824. His ideas were partially accepted in the important 1826 reform, which provided stability and order to the institution and restored its special school. Nevertheless, it has been rightly pointed out that "the Corps, because of its atypical nature, could not find a stable position in the framework of the Bourbon bureaucracy". On the other hand I believe it is misleading to say that the isolation of the Corps in the context of Bourbon administration made evident "the limits of the awareness with which the ruling classes of the south faced problems of modernization"[95]. As the resistance to late eighteenth century economic and administrative reformism could not simply be attributed to the "ignorance" of peasants and government, so the resistance to early nineteenth-century modernization cannot be attributed to some lack of awareness of the ruling classes. In the first case, we noted that very concrete interests were pressing for the maintenance of the feudal-communal systems, and against innovations such as those introduced by Domenico Grimaldi. In the second case, we can rely on the work of social historian Paul Davies, who has shown how the restricted financial and commercial community of the capital had changed during the French period, so that during the restoration age a new group of wealthy investors had complete control over the underdeveloped economy of the kingdom. Convincingly, Davis argued that the backward conditions of the provincial countryside, which was still in a semi-feudal condition, were the very thing which allowed these investors safe and conspicuous earnings. The Bourbons themselves were chronically indebted to Neapolitan bankers, so that a decided impulse in the direction of modernization could hardly be expected from the Crown. The interests of these "entrepreneurs of backwardness", cumulated with the feudal reaction, and with the opposition of local elites to handing their power over to the central government, constituted a serious obstacle for supporters of modernization (mostly professionals, bourgeois landowners, military officers, and ex-members of the French administration).

Traces of the pressure to close down the School of Application are numerous. We know, for instance, from an article in *The Progress*, that in 1835 Rivera had organized a public exhibition of models and projects to show the skills acquired by the students[96]. The anonymous correspondent of *The Progress* did not simply defend the School, but he also accomplished an interesting apology for the figure of the engineer-civil servant[97]. Engineering, we are told, derives from the tendency to satisfy our natural needs but it needs substantial support for the government, given that "there doesn't exist any other profession which needs, besides talent and study, books and machines that a private individual can hardly afford"[98]. After presenting the structure of the courses and the principal textbooks, the author reported on "the public demonstration" which took place between the 6th and 13th of March 1835, where students presented their projects to "a very distinguished and competent audience". There were projects for new harbors, new prisons and suspension bridges. Students also gave conferences on problems of mechanics, hydraulic and descriptive geometry. The real reasons for this demonstration of competence were only touched upon by the author, when he wrote, referring to the curriculum of the School, that

> the acquisition of so much knowledge in so short a period of time could appear improbable to some people; so the illustrious General Director, following a deliberation of S.E. the Minister of Finance, has been forced, this year, to provide a clear and public demonstration.[99]

Pressure on the minister of Finance, who controlled the School during the Restoration age, had been so strong that nothing less than a public demonstration of competence and efficiency had to be organized by Rivera. However, the author concluded with a note of optimism: "These intelligent and educated minds will produce marvelous products, which will make our country not inferior to the most educated and richest regions of Europe"[100].

If Rivera was the authoritative defender of a centralized and rational planning of public works, Giuseppe Ceva Grimaldi, Marquis of Pietracatella (1777-1862), soon became the voice of the conservative opposition. We already met Ceva Grimaldi as protector of the anti-Kantian philosopher Galluppi; now we can add that he was an important men of state, who represented at the highest political level the ideas of the Reactionary Catholic movement. He had received a solid classical education at a religious college, which is evident in his translations of Ovid and Horatius, and in his erudite-rhetorical way of writing, at odds with Rivera's streamlined style. In charge of administrating the feudal possessions of the family, he kept a low profile under the 1799 republic, while in 1800 he was a member of the commission for the re-ordering of public education. Retired to private life during the French period, Grimaldi began his political career in 1815, when the restored king nominated him *intendente*. He administered the most crucial provinces, at a moment when liberal conspiracies were increasing, agreeing with the repressive views of Canosa. A book of his, worth mentioning here, was *Reflections on the Police* (1817), where Grimaldi proved to be a scrupulous reader of Beccaria, Helvetius, Montesquieu and Voltaire, even if his arguments were decidedly reactionary, as he ultimately charged police with directing the "public spirit" towards the return to "the old way of thinking". After the constitutional insurrection of 1820, Grimaldi's career advanced rapidly until he reached the ministry of the interior and of public education in 1830. His political action was mainly devoted to decreasing the pressure on the lowest classes by means of paternalistic decisions such as the lowering of the prices of wheat; he never thought of a general reform of Neapolitan economy, and he rather complained about the abolition of the medieval guilds, which offered protection to workers, and blamed entrepreneurs for the worsening of their conditions of life[101]. About his action in education, we can remember that in 1831 he gave the chair of Logic and Metaphysics to Galluppi, who had not even taken part in the contest; and that he opposed the 1838 project of reform, arguing that elementary education and colleges should be simply given to the religious orders. Grimaldi was then president of the *Consulta Generale del Regno*, an important administrative and juridical organ at the time of the clash with Rivera. In 1840 he became prime minister, giving a repressive character to the action of the government. He left politics when in 1848, the revolution ravaging Naples, King Ferdinando II decided to concede the constitution.

In the debate between Rivera and Grimaldi, the essence of the centralizing reforms was at stake. The Corps was obviously a crucial point, as it was designed to be a powerful instrument to subtract the effective control of the territory to provincial local elites. Reading his pamphlets, it looks as if Grimaldi suspected that the Corps could, through its autonomy from the rest of the administration, threaten the authority of the government, possibly by supporting liberal activity. The liberal orientation of the majority of the engineers is a fact; nevertheless it seems to me that there was a deeper menace which Grimaldi, implicitly, wanted to neutralize, and this was precisely the opposite one, as it was the excessive fidelity of the Corps to the state, but the state which had been theorized by the French, and which was defended by Rivera[102]. Restoring the Corps in its original form would be, for Grimaldi, another step in the direction of this model of the state[103].

Opposite parties had their respective manifestos. In 1832 Rivera collected some previous studies on political economy and some ambitious technical projects and published them under the title *Considerations about the Means to Revalue the Gifts Given by Nature to the Kingdom of the Two Sicilies*[104]. In 1839 Grimaldi published his major work on the way to accomplish public works, which was a direct response to Rivera: *Considerations on the Public Works in the Continental Kingdom from the Normans until Our Days* [105]. From their very titles, the two works show that they belong to opposite conceptual frameworks. Rivera stressed the wealth of natural resources available in the territory of the kingdom, giving no importance whatsoever to their previous forms of exploitation: he was convinced that nothing useful could be derived from studying the economic and technological practices of the past, as they were not guided by truly scientific principles. Rivera was confident that only the power of modern applied sciences, together with natural resources, could transform the kingdom into a modern nation. Grimaldi's considerations, on the contrary, focus upon the long tradition of public works of the previous dynasties. Grimaldi went back to the Norman domination of Naples, in the early Middle Ages, aiming to prove that a local and solid tradition in public works had always existed, and that all that had to be done was to follow the track of the ancestors, whose wisdom was not inferior to the knowledge provided by modern science. Historical perspective is essential to both books, but Rivera saw the present as the starting point, the moment in which, for the first time, a scientific vision of the world was put to work in political and economic life; whereas Grimaldi saw the present as the product of a historical process from which social and political institutions received their legitimization and authority. Grimaldi found laughable the idea that "our civilization began at the time of the institution of the Corps of Bridges and Roads"[106]. The impression is that his arguments tend to make evident an essential homogeneity between the present administration and the present social setting with the previous ones, deleting even the memory of the revolutionary upheaval and of the French period. It has been remarked that Grimaldi's narrative provided the reader with a sense of powerless contemplation of an immutable order, so that "in the restored monotony of the flowing of time, it is impossible to distinguish between present and future", and the future is something "towards which it is impossible to project themselves, it being merely an emanation of the past, and the action of men being marginal in it; men are in fact mere administrators of a reality which cannot be planned and modified"[107]. One should also note the structural analogy between such an argument and the Reactionary Catholic doctrine of the impossibility of accomplishing any truly innovative change in scientific or theological knowledge (which was related to the doctrine of *philosophia perennis*). Philosophers cannot really escape the choice between supporting the theological-philosophical tradition or attacking it with the arguments of skeptics and cynics; administrators cannot really escape the choice between defending the status quo or destroying it according to the revolutionary principles. In both cases things will naturally tend to return to their natural setting.

It has been remarked that the clash between Rivera and Grimaldi was not between two alternative projects of development, as "the use of concepts is so radically different as to result in reciprocal incomprehensibility"[108]. I believe, however, that defining the opposite socio-economic views as "reciprocally incomprehensible" could be rather misleading. It is true that to Rivera's technical plans Grimaldi did not oppose different technical plans, but rather a series of erudite political and historical reflections exclusively based on literary sources. It is also quite true to say that this purely literary matrix made Grimaldi produce a description of the past and present state of the kingdom which was "more a sentimental than a real one"; so that, for instance, "in his reconstruction of the past every canal of the kingdom was navigable, and every road was practicable". On the basis of such a highly ideological description of the past, Grimaldi could confidently argue for the superiority of the administrative institution which had preceded the Corps of Engineers, which could in turn be accused of being too complex and expensive. "Is it really necessary" Grimaldi asked, "to have an exclusive, privileged Corps of engineers charged with the direction of public works?"[109]. The answer was, of course, negative. According to Grimaldi, the works should be accomplished by engineers chosen by the provinces. The general argument consisted in keeping at a minimum level the volume of public works, and in leaving to the local communities the responsibility for their direction. Interestingly Grimaldi remarked that the construction of railroads should be avoided because, if they can be "advantageous for trade", they can also be "advantageous for the enemy" in case of military invasion[110]. This argument matched well with the protest of some local governments against the construction of railroads in the provinces, as they would drain the poorest regions of their population. "Only the future" Grimaldi wrote, "will clarify all the moral and political consequences deriving from such a radical change in the system of communications; but some wise men have already doubts, and foresee dangers"[111]. About the plan to give the construction of new roads to specialized companies, which would be authorized to charge tolls, Grimaldi is ironical: this would be a real "industrial feudalism" he said. Such are the results of *lassez-faire* principle, which seems to "triumph over all the old customs and privileges"[112]. Grimaldi concludes: "if someone would consider us too attached to the old things, we would reply: finding in them some good advice, and returning to them, it is not as mad as it was the idea of entirely condemning them"[113]. What does emerge from reading Grimaldi versus Rivera is the opposition between two models of society, and this is why I believe that talking of incommensurability is inappropriate. The two adversaries saw themselves as threatening each other precisely because they recognized all too well their reciprocal support for such very different models. Every apparently minor, "technical" point (i.e., the number of the engineers, or the title of a textbook of mathematics) was debated with a vehemence that can only be justified by referring to the clear recognition of the opposite underlying social projects. If the concept of incommensurability somehow enters this story, it is with a very different function: not as an explanatory category but rather as a rhetorical weapon wisely used by the actors themselves. Consider Rivera: the legitimization for his dismissal of the traditional administrative system and of the way public works were traditionally accomplished was found in the unprecedented scientific awareness of the new elite of the engineers. Their knowledge was what separated them from the rest of the administrators and the rest of society; and this knowledge was based on the universal language of mathematics. In two words, its was based on the acquisition of the "analytic spirit", as Padula stated so clearly in the very years of the controversy over the Corps. Rivera was using knowledge to single out a group of "experts" who must be guaranteed the monopoly over public works: their rigidly hierarchical and almost military organization will do the rest, with the final result of an effective control of the territory by the central government. Once one has recognized this use of knowledge as legitimating control over previously autonomous areas, one can also see the modern argument about "lack of competencies" in all its ideological significance. Rivera's general strategy consisted in shifting the decision-taking moment to a very "technical" level. Decisions about public works were taken by chief engineers, and the reasoning leading to their decisions was presented as essentially mathematical. This means that the decision process was shifted to a level which was no longer accessible to the members of local administrations and to old-fashioned politicians: they had no role to play in planning the new society (exclusion from the relevant administrative decisions was the issue most commonly raised in the complaints that local administrations sent to the king in 1820). The new knowledge of the engineers, which was essentially knowledge of the analytic language, legitimated them to take full control of the once highly fragmented Neapolitan territory. Not only the sciences had been unified thanks to analysis: the country was as well. The defensive strategy adopted by Grimaldi consisted in eliminating the institutional peculiarities of the Corps, reducing it to a mere branch of administration; this could only be done by de-mystifying the dangerous knowledge of the engineers, by showing they were not the owners of a superior expertise. In fact, if Grimaldi's idyllic description of the pre-Revolutionary conditions of the kingdom contained mythological elements, no less mythological was Rivera's description of an idyllic society founded on the land-owning bourgeoisie, ruled by a strongly centralized government and directed by selected groups of experts whose word is ultimate on every question. Grimaldi, for instance, remarked that the necessary technical ability to build roads and bridges was certainly not found only in the Corps: many Neapolitan artisans and masons were skilled enough to provide the provinces with a wide choice when it came to accomplishing works on their territory (Grimaldi argued indeed for the need of breaking the monopoly of the Corps, referring to the British and the American systems of administration). About the School of Application, Grimaldi proposed to make it "public", that is to open it to everyone, and "not restricted to a few initiated" (he also thought that there were too many professors and too few students) [114]. The "initiated" were those students selected by the difficult entrance exam based, as we have seen, on the knowledge of analysis. It is not difficult to imagine where ultra-conservatives like Grimaldi looked in order to find cultural resources to put in question the legitimacy of the mathematical knowledge of the engineers: an entire battery of arguments was ready-made in the writings of the synthetic school. In turn, the controversy over the figure of the engineer fuelled further the controversy over geometrical methods. The 1839 contest would be hardly understandable without seeing its relevance for the anti-engineers campaign. But, in the end, for the synthetic school it was more a last blaze than a return to the scientific scene. Contested as it was, the modernization process was advancing in the kingdom, and 1840 saw the very significant reform of the Neapolitan system of weights and measures. We can conclude with some remarks over this specific controversy.

In Spring 1840, while Flauti was completing his critical comment of Padula's response to the geometrical contest, the modern party concluded its victorious battle over the rationalization and unification of the measuring system, whose tables of reduction were published by Rivera himself[115]. Previous attempts to unify Neapolitan measures and weights had been made in the reformist period (1780s) but we have seen —through the example of Gallipoli's oil merchants— which kind of interests were entrenched in the discrepancies among the different systems in use. The French government itself had been able only to plan a reform, which was never actuated. It was precisely Rivera and his men who managed to achieve this goal, after a twenty-year campaign (the first plan of reform was dated 1817). A decisive step had been the proposal presented at the RAS by Visconti in 1828; which convinced Rivera to introduce —for the use of the Body and of its School— a new system based on the decimal progression (1830). The system was limited to surface measures, and its terminology was the old one, based on the Neapolitan palm. A decimal system was easier, stated Rivera "and we cannot understand how low people could be more inclined to calculate in what is, in fact, a more difficult way"[116]. A commission, which included Visconti, proposed to extend the use of Rivera's system to the entire society. The *Consulta Generale del Regno*, the administrative organ responsible for such a decision, rejected the proposal in 1837; its president, at that time, was Grimaldi, who defended his decision by publishing a book where the Corps and its School were portrayed as a drain on public finance, and their expertise in matter of weights and measures was explicitly questioned (1838)[117]. The story becomes even more interesting when one finds out that in the same period, a negative judgement over the project of reform was given in a memoir read at the *Accademia Pontaniana* by Ferdinando de Luca, eminent member of the synthetic school and historian of mathematics. This started a polemical exchange between Visconti and Luca, who eventually published a complete version of his criticism in 1839[118]. Meanwhile, in 1838, Rivera had intervened defending Visconti with an extremely well-documented monograph on measure systems. As for Grimaldi, he restated his point in his main book on public works published in 1839. In 1838, Grimaldi's *Considerations on the Reform of Weights and Measures*, was edited by Flauti himself, who added an introductory essay of his own, and a rich apparatus of notes[119]. Grimaldi had in the university professor a powerful ally, who could authoritatively confirm the "scientific" side of his accusations against the unifying methods proposed by Visconti, balancing the support of Rivera and his engineers on the other side. In September 1837, Flauti read with "incredible avidity" a copy of an essay Grimaldi sent to him as it was printed, and wrote him an enthusiastic letter[120]. Flauti was confident that Grimaldi would clarify "the real sense" of the question, as he was convinced that "this matter is within the competence of the wise economists, and not of mathematicians, as it is commonly believed". The boundary-drawing strategy of the synthetic school (pure mathematics/empirical sciences) is here employed to de-legitimize the knowledge of the engineers, and their autonomous action. According to Flauti, mathematicians only began to illegitimately deal with the problem "when a furious freedom, aiming to renew the human race, tried to destroy every ancient costume and habit". In that "very unhappy period" a new system of measures was introduced together with innovations such as a new calendar or the decimal division of the circle ("pernicious to the progress of trigonometry"). Only the metric system survived, but just as a system for scientists. After such a failure, how can it possibly be thought of introducing such a system to the whole of society? It would "change inveterate laws and customs, yielding disorder and confusion among the trading countries"; and Flauti can bring the Roman empire as an example of effective integration of a number of different systems. And indeed, we are told, one of "the good principles of the difficult art of ruling a country" is precisely that "great novelties are always dangerous". In particular "the decimal system, which is excellent for the purposes of calculation", is not equally suitable "for daily trade": intellectual abstractions are out of place when it comes to the empirical world. What is commendable in pure mathematics is not necessarily the best choice for practical purposes, where empirical conditions have to be taken into account. Flauti described this as "an underdetermined problem", and Visconti presented one of many possible solutions, which is certainly not "the most proper", as it is too far from tradition. Consider the fact that, at that time, not only various systems were in use in the kingdom, but that the same unit of measure could differ sensibly. One of the reasons for this quite typical *ancien régime* state of things was the disparity of conditions presented by the Neapolitan territory. So, for instance, traditional surface measures were related to the time or the number of people necessary to work the land. Clearly the units used in the plans and those used in the mountainous regions of the interior could differ. But similar discrepancies, Flauti observed, "have never caused, to my knowledge, any harm to landowners or to the government". Flauti concluded his letter declaring that he "perfectly agree with V.E. that there is no need for altering our measures", that this alteration could be "dangerous"; and that "if we want to give some useful and decorous task to our mathematicians" this should be limited to the exact definition of the Neapolitan palm (without questioning its suitability for practical uses). In his essay, Flauti explained that Grimaldi defended precisely "those ideas that I have always had about this matter"[121]. Flauti also claimed that his criticism of Visconti's plan went back to 1828, when he firstly reported negatively to the RAS. And it seems that in the RAS, which Flauti now described as a "battlefield", a shift of power took place between 1828 and 1838 that had isolated Flauti, to the advantage of Visconti and his "mob" of "young and inexpert collaborators" (the first analytics who were entering the institution). Flauti said he wanted "no responsibility" for what was published in the acts since the early 1830s (he clearly did not have a complete control any more). Visconti emerges from Flauti's remarks as the one who mostly defended the analytics in the RAS; which also make sense of Visconti's stand against inserting memoirs of pure mathematics in the acts[122]. As for Flauti, he had managed to exclude Visconti's 1828 memoir from the publication in the acts, but in the following years he could not effectively oppose the work of the commission on the problem of measures, of which Visconti was part.

Flauti praised the action of Grimaldi as president of the Consulta: decisions about the administration of society must indeed be taken "not by means of mathematical abstractions, that are beautiful but limited to the field of intellect, but looking at the public interest"[123]. Visconti should know how much difference there is between the abstract solution to a question, and its concrete solution – particularly after "his own fatal experiences" Flauti remarked ironically, referring to Visconti's Jacobin past, and to his dismissal following his support to the 1820-21 constitutional government[124]. Flauti's essay offered a historical reconstruction of the "very ancient origin" of the Neapolitan system, showing how it was elaborated in the "happy epoch when men had faith in their own customs, and they did not think of asking scholars to establish their system of measures and weights"[125]. And this wisdom of the common people consisted in varying the unit of measure according to the different places and uses, as Flauti showed with examples. Similarly Grimaldi had argued that "the people always has the monopoly of good sense", and its resistance to modification should be taken by the government as a command. I think there is no need to insist further on the overall meaning of this controversy, except to note that the "conservatives" were soon defeated, as a law of April 1840 introduced a decimal system based on the palm in the continental part of the kingdom. Times were changing, and the "new men" were now defiant, in the scientific academies as well as in the local councils. In 1848 they were to prove their political determination, and their widespread social support.

7.7 The Closure of the Controversy

It is now time to return to our starting point, the 1839 mathematical contest, and to conclude our long story. As the production of Fergola's school in the 1780s and 1790s cannot be properly understood without referring to the contemporary "spirit of analysis" and to its inextricable political dimension, so the historical and Greek-like memoires of the synthetic school published after 1810 make full sense only when contrasted with the beliefs and the practice of the engineers of the analytic school. At the institutional level we have seen that the controversy opposed, roughly, the RUN and the Naval Academy to the Military College and the School of Application. We have also seen that supporters of analytic methods, who welcomed the criticism of Colecchi directed against Fergola's school, were more likely to be engineers involved in the process of modernization of the country. To them Fergola's school was an enormous obstacle to the introduction of French textbooks and analytic expertise into the kingdom. Conversely, the admirers of Greek rigor and neatness saw in the French production the hybridization and corruption of pure mathematics. Synthetics rejected the idea that mathematics can legitimize plans of social reform; the engineers founded their scientific activity on that very idea, as the Jacobins had done before them.

The liberal clergyman Luca de Samuele Cagnazzi (1764-1852) described the controversy over geometrical methods in a remarkably balanced essay, published in the *Analytic Library* in 1812[126]. He was concerned with the didactic aspect of the analytic-synthetic controversy. He noted that algebra, originally used only to treat discrete quantities, was applied by moderns to continuous quantities as well: this originated modern analysis, which is not just "a mere calculus", but a "precise language" to treat "relations among quantities in a universal way"[127]. Given that geometrical analysis was slow and very demanding in terms of memory and concentration, it was inadequate "to treat very complex questions". Instead, the "new language" reduced "geometrical reasoning to the form of algebraic calculus, i.e. of a mechanism, which does not need attention to things, but only manipulation of symbols"[128]. On the other hand he recognized that in synthetic reasoning the "connection between ideas" is "luminous", as it results from both a sound method ("a mechanism of method") and the "specific and very clear" relations between them, from which results a sort of intellectual "satisfaction"; whereas algebraic reasoning produces its results on the basis of only the mechanism of method, so that they are "acceptable only because one trusts such a mechanism", which we "do not distinctly recognize"[129]. Consequently, "it is a deformity to introduce the youth to the mechanism of infinitesimal calculus, differential and integral, through abstract ideas and far from synthesis, as they would act as automata, without knowing the reason for each formula, and without knowing how to apply them to mixed mathematics and to practice"[130]. Cagnazzi complained about the division of mathematicians in opposite "parties", and suggested that both synthesis and analysis should be used at different stages of the curriculum. The party of the "enlightening" synthesis and that of the powerful and "mechanical" analysis were not to follow his recommendations. On the contrary in the 1810s, 1820s and 1830s the controversy remained extremely lively, fueled by the historical and social factors pointed out above. When finally Padula replied to Flauti in 1839, it was to close the exchange, proclaiming the failure of the Fergolian program, and the anachronistic, "useless" nature of Flauti's research. It is a fact that from the early 1840s, with Nicola Trudi moving to the analytic area of research, the synthetic school seemed to have exhausted its forces. When the seventh Congress of Italian Scientists took place in Naples in 1845, it was the analytics who represented Naples to the eyes of the foreigners; and when Steiner and Jacobi came to Naples, they visited the members of the analytic school (1844)[131]. Only the inertia of the Bourbon university system kept Flauti, Bruno and their surviving colleagues at their places until 1860, well after their last significant scientific contributions.

Four years after Padula's reply, in 1843, a study of Fergola's school was written where this was already presented as a phenomenon worthy of being historically investigated, but which had no more scientific relevance. The author, Bernardo Scotti-Galletta, re-presented in a systematic way Padula's crucial criticisms of Flauti, offering what has remained the standard view on the synthetic school of Naples. Scotti's reconstruction contains errors, such as when he claimed that Fergola disliked modern analysis because he did not understand it, but also remarkable insights, as when he recognized that to Fergola algebra and geometry were "two heterogeneous sciences", so that algebra could "alter the purity" of geometry, and "bastardize the rigorous geometry of the ancients" [132]. But in reality, Scotti argued, "algebra simply makes geometry speak its own language". Indeed, geometry was to the ancients "a mute Goddess", only understood by few devotes, whereas today, thanks to Descartes and Lagrange, "it speaks with algebraic language, a language easily understandable by everybody"[133]. Scotti also noted that Fergola's school denied the reality of the remarkable advancements of the last fifty years, and "maintained that mathematics is gradually declining"[134]. His book is precisely devoted to showing the recent advancements of mathematics, the erroneous resistance of Fergola's school against analysis, and the lack of understanding of Fergola and his pupils of modern methods. In fact, all Scotti proved was, once again, that Fergola attributed an essential superiority to geometrical intuition with respect to analytic procedures[135]. Then Scotti compared synthesis and analysis with respect to their application to mechanics, and argued for the convenience of analysis even in those areas where synthesis could be used, in the theory of projectiles for instance. Scotti wrote down a few pages of theorems of this theory from Fergola and, side by side, he inserted the "equivalent" analytic version: the concision of the latter is evident. But one could remark that the "qualitative" definitions offered by Fergola are hardly equivalent to the "abstract numbers" proudly exhibited by Scotti (as in the case of the notion of "velocity" for instance, which to Fergola is something which needs to be understood before determining its value[136]). Moreover, note the structure of his argument: pure mathematics has to be studied *exclusively* as preparation for mixed mathematics; and analysis (being more convenient for treating many difficult areas of mechanics) should be preferred to synthesis from the very beginning of education[137]. He was glossing what in fact was the curriculum of the School of Application. After a long series of specific criticisms raised to passages from works by Flauti and Scorza, Scotti concluded on the historical role of the synthetic school; significantly, he used the past tense.

> The much praised Neapolitan Synthetic School, which was proud to follow the path of the ancients, was exclusively devoted to Scholastic abstractions. If one makes a catalogue of the productions of Fergola and his school, he will find only historical works, translations, and questions of pure mathematics of no interest whatsoever. The young at the time of Fergola lost the best years of their lives working on ancient problems, or on uninteresting problems of pure mathematics, instead of studying pure mathematics as a way to learn the mixed ones, and to apply them to practical needs, as the young do nowadays. And when they modified some ancient solution, or solved some new problem, they thought of themselves as worthy of the name of Geometers.[138]

In the 1840s the "operative" image of mathematics defended by the Neapolitan engineers could finally claim its victory over the last remains of the synthetic image, defended by increasingly isolated university professors. Scotti provided the first complete reconstruction of the last fifty years of mathematics in Naples according to the analytic image, making it part of the more general progress of mathematics in Europe. Going back to the first part of this study, one find precisely in Padula the best expression of that generation of young engineer-mathematicians to whom "the primary goal of mathematics is application", as Scotti said.

The eventual decline of the synthetic school, its incapacity to attract and keep young students (recall Trudi moving to analysis), can be related to the contemporary disappearance of Reactionary Catholicism as a real political option, to the isolation of its philosophical supporters (the reactionary, apologetic tradition), and to the re-orientation of the landed middle-classes in a decidedly anti-Bourbon, liberal and patriotic direction. Born as complementary to a specific reactionary conception of human reason and of its limits, the synthetic school declined with the vanishing of the formidable reactionary block which had re-shaped Neapolitan society and culture between 1790 and 1830.

Notes to chapter seven

1 The country should not be judged *"ni par la noblesse ni par le peuple"*, wrote a counselor of King Joseph; it is only *"dans l'ordre moyen que se conserve le dépôt des lumières"* (quoted in de Martino, *La nascita delle intendenze*, pp.30-31). De Martino comments: "To point at the middle class as the depositary of modern culture, meant to exalt, in the eyes of the king, the good disposition of that relevant portion of society which, since a long time, had welcomed the essential traits of the French model (the so-called administrative monarchy); it was also the way to individuate the social basis indispensable to build the new constitutional and administrative setting, the privileged addressee of the *côde civil*".

2 The law also contained less radical parts."Essentially, the law eliminated in a radical way the baronial privileges which still were limitating the personal freedom and the liberty of work and industry; but it conserved certain rights and special jurisdictions, and attributed them to the *comuni*, which should pay to the barons the equivalent to the previous earning". Even the tithes, as well as many "territorial rights", were maintained (Candeloro, *Storia dell'Italia moderna*, p.331).

3 De Martino, *La nascita delle intendenze*, p.361.

4 Quoted in ibidem, p.363.

5 Ibidem, pp.368-369.

6 Ibidem, p.71.

[7] The Minister of the Interior, through a rigid hierarchical system, could strictly control the entire peripheral personnel. It also exercised its control on the administration of the *comuni,* of prisons, hospitals, hospices, public works, on agriculture, trade, manufacturing, and public education.

[8] The *intendenza* was the crucial element of the new administrative system; it had been the instrument for the abolition of feudalism and of the redistribution of common lands. As baronial reaction rose in intensity, minister Zurlo and his *intendenti* were frequently accused of preparing some sort of "agrarian revolution", based on the abstract principle of equal redistribution of land. The *intendenze* were also responsible for public works, in particular those regarding internal viability, which were considered crucial to solve the problems of agriculture and trade.

[9] De Martino, *La nascita delle intendenze,* p.220.

[10] Related to this argument was the flourishing of literature about the moral values of the uncorrupted country life, and the exaltation of the "wise peasant". See for instance Paolo Nicola Giampaolo, *Lezioni e catechismo di agricoltura* (Naples: 1808). In this textbook of agriculture, the reactionary philosopher Giampaolo showed little sympathy for the chaotic towns, and exhorted his fellow-countrymen to "look in the countryside for wealth, tranquillity, and innocence: there one does neither hear seditious voices, nor one sees intrigue against the state" (pp.10-11). I have argued that this sort of literature is crucial to understand the remarkable success of the landscape painting of the School of Posillipo, in the decade after the Restoration.

[11] Amodeo, *Vita matematica napoletana,* vol.2, p.46.

[12] See ibidem, p.167.

[13] Medicine had seven chairs (Texts of Hippocrates was abolished), Philosophy had six (Logic and Metaphysics, Mathematics, Transcendental Mathematics, Mechanics, Experimental Physics, Astronomy), and the Natural Sciences had five (Chemistry, Botany, Mineralogy and Metallurgy, two chairs of Zoology).

[14] The faculties were: Literature and Philosophy (ten chairs), Mathematics and Physics (nine chairs), Medicine (nine chairs), Law (seven chairs), Theology (four chairs). The professors were forbidden to teach elsewhere, and to nominate substitutes (which created something of a problem to the over-employed members of Fergola's school).

[15] Vincenzo Cuoco, "Rapporto al Re Gioacchino Murat e progetto di decreto per l'organizzazione della pubblica istruzione" (1809) in Vincenzo Cuoco, *Scritti Vari. Parte seconda: periodo napoletano (1806-1815) e carteggio* (Bari: 1924) pp.3-122.

[16] See ibidem, pp.32-33; pp.65-68; and pp.156-157.

[17] Giuseppe Russo, *La scuola d'ingegneria di Napoli, 1811-1967* (Naples: Istituto Editoriale del Mezzogiorno, 1968) p.40

[18] Giannattasio and Sangro maintained their chairs (respectively: Conic Sections plus Sublime Calculus, and Military Architecture plus Fortifications). Other disciplines were: Practical Geometry, Spherical Trigonometry, Mechanics and Physics, Stereometrics, Descriptive Geometry.

[19] *Saggio di un corso di matematiche per uso della Real Scuola Politecnica e Militare,* 12 vols. (Naples: 1813-1815).

[20] On the schools of engineering in Italy during the French occupation, see Luigi Pepe, "La formazione degli ingegneri in Italia nell'età napoleonica", *Bollettino di storia delle scienze matematiche,* 1994, 14:159-193. On the Neapolitan school see Russo, *La scuola di ingegneria di Napoli.*

[21] Campredon was also Minister of War of the Kingdom of Naples (1809). In 1812 he left Naples to follow Napoleon in the Russian campaign, heading a Neapolitan army.

[22] See Russo, *La scuola d'ingegneria di Napoli,* p.44.

[23] Amodeo, *Vita matematica napoletana,* p.174.

[24] See Russo, *La scuola 'dingegneria di Napoli,* p.48.

[25] Quoted in ibidem, p.53.

[26] Quoted in ibidem, p.56.

[27] See ibidem, pp.56-57.

[28] "Sulla Scuola di Applicazione annessa al Corpo de' Ponti e Strade del Regno di Napoli", *Il progresso delle lettere, delle scienze, e delle arti,* 1835, 10, p.330. The article is signed "L.R." (Raffaele Liberatore?).
[29] Hydrodynamics and applied mechanics (see ibidem, p.332).
[30] The first problem was the following: "Trace the tangent plane to an ellipsoid and to a sphere, whose center lie in the axis of that one, and let it be inclined with respect to another given plane at a known angle" (idem).
[31] About the more convenient rotation among certain agricultural products.
[32] About the different procedures to extract iron from minerals, and the best procedure to produce steel.
[33] In this case, the pupils had to prepare the project of a music hall (plan, prospect, vertical section, shadows).
[34] Carlo Afan de Rivera, *Considerazioni sul progetto di prosciugare il lago Fucino e di congiungere il mare Tirreno all'Adriatico per mezzo di un canale navigabile* (Naples: 1823) pp.29 and 38. Rivera ideated the two first suspended bridges ever built in Italy, and directed numerous works of land reclamation and road building. He also wrote on the introduction of "full property" in Calabria (*Dello scioglimento della promiscuità della proprietà nella Regia Sila* (Naples: 1828)).
[35] *Biblioteca analitica di lettere, scienze e belle arti;* and from 1812: *Biblioteca analitica di istruzione e di utilità pubblica.*
[36] See Ottavio Colecchi, "Se la sola analisi sia un mezzo d'invenzione o s'inventi dalla sintesi", *Il progresso,* 1836, 14:213-228; Ottavio Colecchi, "Saggio sulle leggi del pensiero", ibidem, 1837, 16:161-192; Ottavio Colecchi, "Sulla induzione matematica", ibidem, 1837, 17:55-74; Ottavio Colecchi, "Sul paraboloide ellittico iperbolico", ibidem, 1838, 22:41-48; Ottavio Colecchi, "Questione relativa al primo problema di filosofia; se le nostre sensazioni siano esterne di lor natura, o tali diventano in forza dei giudizii abituali", ibidem, 1843, 32:43-58.
[37] "Breve memoria filosofica sulla generazione e l'avanzamento delle scienze e delle arti", *Biblioteca analitica di lettere, scienze e belle arti,* 1810. The article continued on the first number of 1811, reporting the advancements in the "moral sciences" (pp.1-31), and in the physico-mathematical sciences (pp.31-80).
[38] Ibidem, p.1.
[39] Ibidem, p.4.
[40] Ibidem, part 2, p.15. The quote is from Lucretius (2, 251).
[41] Jean-Louis Boucharlat, *Théorie des courbes et des surfaces du second ordre, precedée des principes fondamentaux de la geometrie analytique* (Paris: 1810). The book is dedicated to Lagrange.
[42] 1810, 2, serie Memorie...
[43] Joseph-Louis Lagrange, *Théorie des fonctions analytiques, contenant les principes du calcul différentiel, dégagés de toute considération d'infiniment petits ou d'evanouissans, de limites ou de fluxions, et réduit à l'analyse algébrique des quantités finies* (Paris: 1797).
[44] Sylvestre-Françoise Lacroix, *Traité du calcul différentiel et du calcul intégral,* 3 vols. (Paris: 1797).
[45] "Programma", *Biblioteca analitica d'istruzione e di utilità pubblica,* 1812, 1:3-203.
[46] Ibidem, p.4.
[47] Ibidem, p.18.
[48] Ibidem, p.22-24.
[49] Ibidem, p.10.
[50] Cabanis, *Rapports du physique et du moral de l'homme.*
[51] "Programma", p.42.
[52] Ibidem, p.39.
[53] Ibidem, p.65.
[54] Ibidem, pp.66-67.
[55] Ibidem, .70.
[56] Ibidem, p.137.
[57] Ibidem, p.192.
[58] Ibidem, p.194.

[59] Ibidem, p.203.
[60] Ibidem, p.196.
[61] See Gaetano Sabatini, *Ottavio Colecchi: Nuove notizie e documenti* (Rome: 1929) p.31. This remains the most detailed biographical study on Colecchi.
[62] Ottavio Colecchi, "Su i punti di regresso della seconda specie", *Biblioteca analitica*, 1813, 3:321-331. Here he deals with the problem of determining the second-degree points of a generic curve.
[63] Colecchi's own words, quoted from a letter reprinted in Antonio Capograssi, "Nuovi documenti sull'accusa di ateismo ad Ottavio Colecchi", *Samnium*, 1940, 13:73-89, p.75. This article, and Alfredo Zazo, "La nomina del Galluppi a professore di Logica e Metafisica", *Logos*, 1925, 8:102-115, provide useful material in order to reconstruct the real nature of the accusations against Colecchi.
[64] As seen above, the foreigner was Giovanni Plana.
[65] Quoted in Capograssi, "Nuovi documenti", p.89.
[66]At least thirty thousand Neapolitan citizens, called *attendibili*, were similarly controlled. They were forbidden to leave their own town, and they relatives were prevented from attending university courses. In 1825, it was prescribed that every student had to attend the the *congregazioni di spirito* (spiritual congregations), and to accomplish the proper spiritual exercises, in order to be admitted to the university examinations. It was already compulsory, for every university student, to present a certificate of good conduct signed by the major of their town of residence, by the priest of their parish, and by a royal magistrate. Moreover, taxes on foreign books were increased, and every private citizen had to declare, to a specific "commission for the revision of books", which books were in his house.
[67] The sonnets are in Sabatini, *Ottavio Colecchi*, p.49.
[68] Galluppi began to work in the usual Wolffian framework of late eighteenth century Neapolitan scholastic philosophy. From 1800 he re-elaborated themes from Locke, Condillac, and Kant, in opposition to the strong current of Neapolitan sensationalism and *ideology*. He attacked sensationalism in his *Sull'analisi e sulla sintesi* (Naples: 1807); rejected Kantism because ultimately leading to scepticism; and reached a position in many ways analogous to that of the Scottish common-sense school (which he knew through the mediation of the French eclectics). The starting point of any philosophical analysis is consciousness, which is the awareness that the *ego* has of itself and of a separate, independently existing reality. By means of the evidence provided by consciousness, Galluppi found in the ego the universal ideas denied by the empiricists, including the idea of God. True knowledge consists in rearranging, by a real synthesis, the objective unities of beings just as they are. See his *Saggio filosofico sulla critica della conoscenza*, 6 vols. (Naples: 1819-1823).
[69] Sanseverino is considered as the crucial author in the elaboration of Neo-Thomism. In 1846 he founded in Naples the *Accademia di Filosofia Tomista*. He taught "Logic and Metaphysics" at the Archiepiscopal College (*Liceo Arcivescovile*), and Ethics at the RUN (1851-1860). See Pasquale Orlando, "Vita e opere di Sanseverino" in Orlando, *Il tomismo a Napoli*, pp.42-107.
[70] *La scienza e la fede. Raccolta religiosa, scientifica, letteraria ed artistica che mostra come il sapere umano renda testimoninanza alla religione cattolica.* From the front page of the fifth volume (1843), we know that the periodical was part of the publications of the *Biblioteca Cattolica* (Catholic Library), protected by the Reactionary Catholic monsignor Celestino Cocle, Archbishop of Patras and private confessor of King Ferdinando II.
[71] "Delle teorie kantiane difese da Ottavio Colecchi nella sua opera che ha per titolo: Sopra alcune quistioni le più importanti della filosofia, Napoli 1843", *La scienza e la fede*, 8:5-32, p.5. The article is signed "The editors".
[72] Noteworthy is Colecchi's rejection of the Kantian doctrine of schematism.
[73] "Delle dottrine kantiane difese da Ottavo Colecchi", p.7.
[74] Ibidem, p.22.
[75] Ibidem, pp.27-28.
[76] See Orlando, *Il tomismo a Napoli*, p.54.
[77] Ottavio Colecchi, "Sull'induzione matematica", *Il progresso delle scienze delle lettere e delle arti*, 1837, 17:55-73. Colecchi founds the certainty of the process of mathematical induction on

its being "an operation of the self"; he can in this way reject the criticisms of those who believe that the principle is "shaking", and that it would pollute the necessity of mathematics, by introducing contingent elements.

[78] See Sabatini, Ottavio Colecchi, p.61.

[79] Amodeo, *Vita matematica napoletana*, vol.2, p.121.

[80] Ibidem, p.137.

[81] Francesco Tucci, "Soluzione di un problema creduto da Lagrange difficilissimo a trattarsi colla geometria", *Biblioteca analitica d'istruzione e utilità pubblica*, 1812, 2:321-326.

[82] Francesco Tucci, "Soluzioni analitiche del problema delle quattro sfere condotto a fine col metodo delle coordinate", *Atti della Società Pontaniana di Napoli*, 1812, 2:257-279.

[83] Francesco Tucci, "Soluzione di alcuni problemi relativi alle curve coniche ed alle superficie generate dal rivolgimento di esse intorno a' loro assi primarii, eseguita coll'analisi degli antichi geometri", *Atti della Società Pontaniana*, 1819, 3:131-148.

[84] The *Società Pontaniana* subscribed to Gergonne's journal since 1817 (see Amodeo, *Vita matematica napoletana*, vol.2, p.146).

[85] Francesco Tucci, *Osservazioni sul problema della piramide triangolare e nuova sua risoluzione analitica* (Naples: 1823).

[86] Francesco Tucci, *Ricerche analitiche sulla simiglianza delle curve piane con appendice sulla simiglianza delle superficie curve e delle curve a doppia curvatura* (Naples: 1826).

[87] Francesco Tucci, *Della misura delle volte rette ed oblique, trattato teorico e pratico* (Naples: 1832).

[88] Claude Navier, *Résumé des leçons d'analyse données à l'École Polytechnique*, 2 vols. (Paris: 1840). Engineer of Bridges and Roads, Navier was known for the realization of suspended bridges; he wrote a *Mémoire sur les ponts suspendus* (Paris: 1823). He taught analysis and applied mechanics at the *École de Ponts et Chaussées* (from 1819), and at the *École Polytechnique* (from 1831).

[89] Charles Leroy, *Traité de géométrie descriptive* (Paris: 1842). He taught descriptive geometry and its applications for more than thirty years at the *École Polytechnique*, and published on the application of analysis to solid geometry.

[90] Amodeo, *Vita matematica napoletana*, vol.2, p.122.

[91] Ibidem, p.269.

[92] See Russo, *La scuola di ingegneria*, p.77.

[93] Fausto de Mattia and Felicita de Negri, "Il Corpo di Ponti e Strade dal decennio francese alla riforma del 1826", in Angelo Massafra (ed.), *Il mezzogiorno preunitario. Economia, società e istituzioni* (Bari: Dedalo, 1988) pp.449-468; p.462.

[94] ibidem, p.450. They remark that, before 1809, the engineer "was in a condition of social inferiority", characterized by "the uncertainty of his professional definition".

[95] Ibidem.

[96] "Sulla Scuola di Applicazione annessa al Corpo di Ponti e Strade del Regno di Napoli", see above.

[97] He begins by quoting from North-Italian "progressist" Melchiorre Gioia, according to whom "a corps of engineers devoted to the direction of the waters and the roads is a sign of wise administration" ("Sulla Scuola di Applicazione", p.328).

[98] Ibidem, p.330.

[99] Ibidem, p.332.

[100] Ibidem, p.333.

[101] See Giuseppe Ceva Grimaldi, *Del lavoro degli artigiani* (Naples: 1845).

[102] See Anna Giannetti, "L'ingegnere moderno nell'amministrazione borbonica: la polemica sul Corpo di Ponti e Strade" in Massafra, *Mezzogiorno preunitario*, pp.935-944; p.937.

[103] "[S]till in 1781, the Bourbon administration had not managed, in spite of the repeated appeals of the King, to modify the route of the royal road of Apulia, because of the opposition of the provinces, which resisted any attempt to modify the existing order" (Giannetti, "L'ingegnere moderno", p.937).

[104] Carlo Afan de Rivera, *Considerazioni sui mezzi da restituire il valore proprio ai doni che la natura ha largamente conceduto al Regno delle Due Sicilie*, 2 vols. (Naples: 1832). A third volume devoted to Sicily was published in 1842.
[105] Giuseppe Ceva Grimaldi, *Considerazioni sulle opere pubbliche della Sicilia di qua del Faro dai Normanni sino ai nostri tempi* (Naples: 1839).
[106] Ibidem, p.173.
[107] Giannetti, "L'ingegnere moderno", p.941.
[108] Ibidem, p.942.
[109] Grimaldi, *Considerazioni sulle opere pubbliche*, p.151.
[110] Ibidem, p.155.
[111] Ibidem, p.170.
[112] Ibidem, p.173.
[113] Ibidem, p.179.
[114] Ibidem, p.169.
[115] Carlo Afan de Rivera, *Tavole di riduzione dei pesi e delle misure delle Due Sicilie, in quelle statuite dalla legge 6 aprile 1840* (Naples: 1840).
[116] Carlo Afan de Rivera, *Della restituzione del nostro sistema di misure, pesi e monete alla sua antica perfezione* (Naples: 1838) p.13.
[117] Giuseppe Ceva Grimaldi, *Considerazioni sulla riforma dei pesi e delle misure nel Regno delle Due Sicile al di qua del Faro* (Naples: 1838). I have consulted the second edition, edited by Flauti. The indication of 1839 as the date of publication of this book (*Dizionario biografico italiano*, sub voce "Grimaldi") is clearly incorrect.
[118] Ferdinando de Luca, *Esame critico di alcuni opuscoli pubblicati intorno al sistema metrico della città di Napoli* (Naples: 1839).
[119] See note 116.
[120] Letter of Flauti to Grimaldi, in Grimaldi, *Considerazioni sulla riforma dei pesi*, p.xlvii.
[121] Ibidem, p.iv. Flauti added that, during the French period, he "had to hidden" such ideas.
[122] Ibidem, p.ix.
[123] Ibidem, p.xvi.
[124] Ibidem, p.xvii.
[125] Ibidem, p.xxv.
[126] Luca de Samuele Cagnazzi, "Sull'uso della sintesi e dell'analisi nell'istruzione delle scienze matematiche", *Biblioteca analitica d'istruzione e di utilità pubblica*, 1812, 2:19-36. Cagnazzi was professor of political economy and statistics at the RUN since 1801, and a counselor of the French government (1806-1815). He maintained his positions immediately after the Restoration, but was eventually removed for his participation in the 1820-21 constitutional government. He was interested in didactic issues because of their relevance to the progress of the country: his contribution is eclectic as he aimed to show the advantages and disadvantages of the various methods, and to mix them in the most appropriate way. But his name is mostly known for his studies of statistics, published as *Elementi dell'arte statistica*, 2 vols. (Naples: 1808-1809).
[127] Ibidem, p.19.
[128] Ibidem, p.21.
[129] Ibidem, pp.26-27.
[130] Ibidem, p.30.
[131] On this episode see Loria, *Nicola Fergola*, pp.132-135.
[132] Bernardo Scotti-Galletta, *Osservazioni critiche su la scuola sintetica napolitana* (Naples: 1843) p.4.
[133] Ibidem, pp.4-5.
[134] Ibidem, p.6.
[135] See ibidem, p.12 and p.19.
[136] See ibidem, p.28.
[137] See ibidem, p.26.
[138] See ibidem, pp.133-134.

Conclusions

I began to work on this study with some basic goals in mind. Firstly, I wanted to reconstruct a specific mathematical controversy which, apart from a couple of works dating from to the late nineteenth century, had never been an object of study. Surprisingly, the very memory of Fergola's synthetic school and of its battle against modern analysis was lost in the second half of the century, so that in 1892 the historian Gino Loria declared that he came to know about the school only through the references contained in the history of geometry by Michel Chasles (1837). The reasons of such a lack of memory are very much linked to the cultural politics of the new unified Italian nation, and go beyond the limits of the present study. What is relevant here is the permanence of a historiographic judgment about the overall production of the school as merely backward and as such not worthy being investigated. This is indeed the opinion of the authors of recent histories of Italian science. The historical reconstruction presented in this study aimed to challenge this judgment, and to call into question precisely that backwardness which is usually assumed as an explanatory concept in itself. I concluded that Fergola and his school were not a relic of the past, but a new anti-modern response to the "spirit of analysis" and to its cultural project. Certainly the synthetics, not unlike Maistre and the political reactionaries, constructed their own identity as one linked to an ancient tradition, but historians should handle such ideological self images with caution.

This brings me to another series of considerations, regarding my specific interpretation of the controversy. In the end, it should be clear that if there was a tradition in which to work in order to revive Neapolitan mathematics in the 1780s it was the analytic tradition. The fact that no strong schools of mathematics existed in Naples, and that French books were freely circulating in the kingdom were conditions for a rapid diffusion of the purely analytic approach. In this context, looking at the ancients was not a straightforward choice for Fergola, a young mathematician who admired Genovesi, frequented the enlightened intelligentsia, the library of Marquis Berio, and who had studied with Caravelli, author of the first treatise of integral and differential calculus ever published in Naples. This convinced me that his "geometrical" choice was grounded on some basic disagreement on the very nature of mathematics, and this has turned out to be the case. Indeed we have seen the sort of intuitive, non-mechanical and fundamentally non-creative conception of mathematics that legitimized the synthetic practice of problem-solving. But at this stage, one cannot escape the deep cultural and social meaning of this conception of mathematics, and the fact that it emerged precisely when reformist and revolutionary claims were being grounded on the alternative purely analytic conception, according to which analysis was the universal language of reason, and its applicability was virtually unlimited. The discovery of the network of the Neapolitan reactionary intelligentsia, which included well-known scientists such as Fergola, together with politicians, ecclesiastics and literati, strengthened my conviction about the anti-modern and reactionary aim of the scientific production of the synthetic school.

The interpretation of Fergola and his pupils as privileged because Bourbon loyalists and orthodox Catholics, should be integrated with considerations on how the cognitive content of their scientific work was shaped to reinforce the reactionary Catholic fight against the revolution and, later, against what we called the "modernization" of society. In fact, the interpretation provided in this study only works if one agrees with attributing a causal relevance to cultural and social factors upon scientific production. I believe this study makes a strong point in favor of such a hypothesis. In particular, it should be noted that in our story certain mathematicians changed their beliefs about the proper problem-solving method and about the nature of mathematics during their lives. Now, this was never detached from changes in their beliefs about the political and social setting of the kingdom. So the young Fergola, a Genovesian student interested in the practical application of mathematics and in economic reforms, began by working on calculus and its applications; then, in correspondence with the strengthening of his religious and political conservatism, he gave birth to the purely geometrical Euclidean project. In the case of Giordano things went the other way around: from being a brilliant *enfant prodige* of Fergola's school, whose Greek-like style was admired in Naples and abroad, he became a strenuous defender of the analytic approach as his radical political ideas took shape. In the following phase of the controversy, we have seen members of the synthetic school move to the analytic field, such as Tucci and Trudi, whose liberal ideas were well known. This stories do indeed support the hypothesis of a causal effect of more general orientations upon scientific beliefs. Indeed, these are cases where, in presence of a common education and mathematical training, the only relevant discriminatory factors seem to be precisely the political and religious orientations of the actors. In this respect, the present study brings further historical material to strengthen the tenets of that stream of sociohistorical analyses which are inspired by the theoretical assumptions of the sociology of scientific knowledge.

With respect to the more specific debate in the historiography of mathematics about the interpretation of the changes in the mathematical practice of the early nineteenth century, the present study suggests a new perspective. Previous "social" interpretations, such as that which related the birth of pure mathematics to the professionalisation of research in Prussia (possibly one of the most convincing), seem to be less fruitful in the reconstruction of the Neapolitan case. This tells us of the importance of carefully considering the local conditions of each case-study, and of the variable nature of the resources which can be employed by social historians in constructing their interpretations. The most convincing interpretation for the Neapolitan case appears to be one which privileges the causal role of Reactionary Catholic thought upon scientific production and didactic. This certainly does not exclude the action of other causal elements such as processes of professionalisation; they are simply less relevant. New investigations should explore the presence of such causal factors as have emerged in the case of Naples. It would be interesting to know the role played by forms of conservative thought upon mathematical practice in other European countries. There are reasons to believe that at least in certain cases, such as Cauchy's project of the "rigorization of calculus", this ideological factor played a primary role. That the unprecedented need of providing "sound foundations" for mathematics, and the equally unprecedented stress on the fundamental role of "pure mathematics", could be interpreted in the light of the contemporary emergence of radical forms of conservative thought all over Europe, is a fascinating hypothesis worthy of further investigation.

A few words about the generality of the present findings. One might wonder whether the present interpretation holds at least for the wider Italian context. Which is to say: is it the case that elsewhere in Italy mathematicians involved in the Reactionary Catholic network favored purely synthetic methods and planned to provide geometrical foundations for the entirety of mathematics? Well, very simply this is not the case. The algebraist Paolo Ruffini (1765-1822), from the Ducat of Modena, was, like Fergola, a member of the Academy of Catholic Religion, and he contributed to the Reactionary Catholic journal of father Baraldi. He provided not only the well-known proof of the impossibility of solving by radicals equations of degree superior to the fourth (1799), but also a proof of the spirituality of the soul. The devout and conservative side of this loyalist professor —one of the very few to refuse the oath to the Napoleonic government— has never been studied, let alone linked to his mathematical practice. But in fact this was decidedly "analytical", if we continue to adopt the Neapolitan criteria. Now, I believe that the consideration of Reactionary Catholic mathematicians such as Ruffini, or the Milanese Gabrio Piola, only strengthen our interpretation of the Neapolitan case. Consider the following. I argued that rising Reactionary Catholic thought had a causal role in shaping the theory and practice of the synthetic school in Naples. But of course this causal factor acted upon a pre-existing tradition of mathematical teaching and research. The peculiarity of Naples, in this respect, was the absence of full-time specialists devoted to advanced research in mathematics; good teachers were active at the military schools, but they were entirely absorbed by their (practically oriented) teaching duties; whereas at the RUN only elements of geometry and algebra were taught, mostly to students of medicine and law. In this context, where the penetration of eighteenth-century analysis had been extremely limited, the return to the Greek models and to synthesis was a viable option to a "restorer of science" such as Fergola. In Northern Italy things were very different. The French analytic research and its applications to empirical sciences had long since penetrated the universities and the academies, where advanced research was done, particularly in hydraulic applications (due to the technical problems related to the complex system of irrigation of the Po Valley). In this context, in the 1790s, the proposal of a geometrical conception of mathematics and of the priority of synthetic methods over analytic ones was simply not a viable option for men like Ruffini and

Piola. Nevertheless, their scientific production pursued equally apologetic aims: we find very clearly stated the separation between pure and applied mathematics, and the ontological and epistemological superiority of the first over the second. As in Naples, the weakness of human reason in empirical (scientific and political) questions was opposed to its "sublime" working in the ethereal field of pure mathematics, the only portion of knowledge where absolute certainty is reachable by human beings. Only, in Northern Italy pure geometry was replaced with pure analysis as the most proper "spiritual" discipline, i.e. the field of action of pure intellect as opposed to any practice which include the polluting presence of "matter". This legitimized a boundary-drawing strategy whose effects upon didactic and research were comparable with those in Naples. And, through the North-Italian case, we can also see more clearly along which lines an extension of the present study could reconstruct the action of reactionary thought upon mathematical knowledge in cases such as those of Cauchy, a devote Catholic, a Bourbon loyalist and the most famous cultivator of pure mathematics of the period, or of the German "purists".

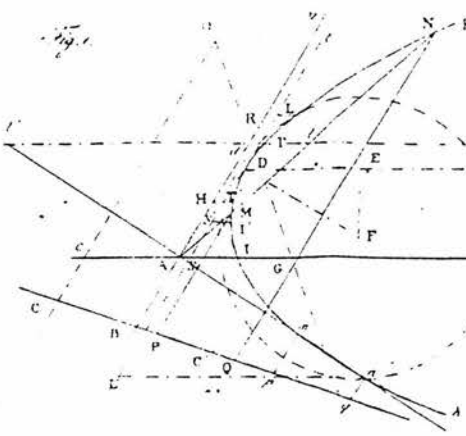
I would like to conclude with a few remarks upon the more general theme of the production of scientific knowledge "in a conservative culture". I have already suggested that such a theme has not been given much space in the historiography of science. In this study, I have shown that, at the turn of the nineteenth century, a specific form of conservative thought had momentous effects upon the production of scientific knowledge. In the same way as contemporary pieces of art, or contemporary theological and philosophical works, every piece of scientific research produced in Naples at that time tells us of the battle for the modernization of the country. In the case of mathematics, the causal action of conservative goals is recognizable in the emergence of such crucial themes as the perspicuity of geometrical knowledge, its intuitive nature, and its absolute certainty —which derives from its being a mere mirroring of a transcendent state of things. Coherently with these assumptions, mathematical practice was portrayed as essentially "local", and specific methods for solving problems and proving theorems were taken to be valid only in restricted areas of mathematics. There was nothing like a "universal method" in mathematics, let alone in science. Mathematics was rather a "motley of techniques", whose ultimate foundation and legitimization was provided by non-linguistic geometrical intuition. Mathematical techniques were not only considered unreliable when applied to solve empirical problems outside mathematics, but within mathematics itself specific methods had only a limited range of application. This image of mathematics, and the correspondent practice and didactic, were clearly connected to the specific conception of human reason which was at the core of the entire anti-modern reaction of early nineteenth-century intransigent Catholicism. According to this conception, human reason could only be properly used within narrow and pre-defined spheres of investigation, and its functioning was essentially passive, consisting in a mere "recognition" of truths (intuition is invariably portrayed as the act of "seeing" by means of the intellect). Such an image of reason was initially constructed using the theoretical material provided by the works of the early Reactionary Catholicism (characterized by a new, anti-intellectual apologetic style, based on the re-elaboration of patristic literature) and by French Traditionalism. At a later stage (around the 1820s), a revised version of the Thomistic theory of knowledge was chosen as the main basis for the new Neo-Scholastic current, which was born in Naples, and which soon became dominant in Catholic theology worldwide. The boundaries of human reason were in this way legitimated by an authoritative and fully orthodox tradition.

The picture is not complete if it does not include the "modern" image of knowledge which was the target of this cultural reaction. As I have shown, it was an image mainly derived from the traditions of French sensationalism and of *ideology*, opportunely re-elaborated by Neapolitan reformers and by Neapolitan Jacobins. As in the case of conservative thinkers and politicians, I have found that the consideration given by historians to reformist and Jacobin sociopolitical thought is not enough to fully assess their historical significance. Their scientific productions must also be taken into account. In particular, we have seen that in the case of Lauberg and of his students, mathematical research was far from being a mere "cover" for conspiratorial activity, as it is generally argued. In Lauberg's school, as in Fergola's school, mathematical knowledge was clearly shaped by social and political goals. Similarly, in the later phase of the controversy, the civil engineers of Rivera rescued the analytic image of mathematics in view of its utility for their liberal and reformist goals. The mathematical research and teaching of the analytics was grounded upon an image of human reason which knew no limits for the application of its creative faculty. Algebraic reasoning was conceived as the universal language of reason, and its application to the solution of any sort of problems inside and outside mathematics was seen as just a matter of time. Consequently, their problem-solving practice was based on the adoption of very general methods, regardless of the specific field to which they were employed. The results received their legitimization not from the non-linguistic intuition, but from the analytic style of reasoning itself, which was seen as the highest form of rationality. That every individual, with a little practice, could become a good problem-solver, was simply nonsense to the synthetics; as was the claim that mathematical methods could be fruitfully employed outside mathematics. These views were strenuously opposed by Flauti and the other disciples of Fergola, who resisted any change in university curricula as well as in the social and cultural settings of the kingdom.

Finally, I have shown how Reactionary Catholicism not only shaped mathematical knowledge, but also other branches of scientific knowledge. The experimental activity of natural philosophers such as Poli, and of anatomists such as Cotugno, is indeed best understood by placing them in their proper cultural dimension, which was that of the Catholic reaction, and of political loyalism. In their works, as in Fergola's textbook of physics, I have identified a form of "apologetic empiricism", which is strictly connected with the rigid division between pure and mixed mathematics defended by Fergola's school. Both apologetic empiricism and the synthetic image of mathematics are grounded in the conservative image of individual reason, according to which reason is unable to transcend the empirical dimension, and to achieve certain knowledge about empirical matter-of facts. In the empirical sciences, as in the case of mathematics, conservative thinkers stressed the boundaries and the differences between different methodologies. Generalization and formalization of "local" empirical knowledge were portrayed as dangerous procedures, often leading to mistakes. The use of mathematics in the empirical sciences was reduced to a minimum, and it was made clear that natural and social realities cannot be "understood"; human knowledge of them was seen as necessarily fallible and hypothetical.

The impact of forms of conservative skepticism upon the practice of science at the beginning of the early nineteenth century was probably much more significant than is usually believed. Furthermore, most of the cultural resources employed by nineteenth and twentieth-century forms of conservative thought were elaborated precisely at that time. Irrationalist, anti-intellectual and anti-modern conceptions of knowledge were to return frequently to themes such as the limits of mathematical knowledge, the risks connected to the mathematisation of reality, and to the powerful theological image of individual reason as a "light trembling in the darkness".

Appendix 1



PROBLEMA I.

1. *Data* (*Fig. 1.*) *la parabola* KIk, *il diametro* AIx *e in esso il punto* A, *e data la retta* BQ; *condurre la retta* AMN *in modo che inclinate le rette* MP, NQ *sotto un medesimo angolo dato al diametro* Ax, *sia la parte* PQ *che intercettano sulla* BQ, *uguale ad una data retta.*

Condotta per A la AR che faccia col diametro Ax l' angolo RAx uguale al dato, si prendano per assi coordinati le rette Ax, AR : sia la tangente applicata alla parabola in D parallela ad AR : e chiamando α, β le coordinate del punto D, $2p$ il parametro della parabola corrispondente al diametro che passa per D, e t, u le coordinate del punto M, le equazioni della parabola e della AMN saranno

$$(y-\beta)^2 = 2p(x-\alpha) \ldots . (1), \; y = \frac{u}{t}x \ldots .. (2),$$

dalle quali eliminando y, avremo

$$u^2x^2 - 2(\beta ut + pt^2)x + t^2(\beta^2 + 2p\alpha) = 0.$$

Avendo questa equazione una radice uguale a t, l' altra sarà

$$\frac{2(\beta ut + pt^2)}{u^2} - t.$$

Ma supponendo che

$$y = ax + b$$

sia l' equazione della BQ, si rileva che, dinotando con x, x' le ascisse de' punti P e Q, e con c il coseno dell'angolo degli assi,

$$PQ = (x' - x)\sqrt{1 + a^2 + 2ca} \ldots . (3); (*)$$

dunque poichè i punti P e Q hanno le stesse ascisse de' punti M N, chiamando $2d$ la data retta, otterremo l' equazione

$$\left(\frac{\beta ut + pt^2}{u^2} - t\right)\sqrt{1 + a^2 + 2ca} = d,$$

che unita all' equazione

$$(u - \beta)^2 = 2p(t - \alpha) \ldots ... (1'),$$

la quale si deduce dalla (1) osservando che il punto t, u (**) appartiene alla parabola, serve a determinare t, u. Facciamo per semplicità di calcolo

$$\frac{d}{\sqrt{1 + a^2 + 2ca}} = d',$$

(*) Difatti per le note regole dell' analisi a due coordinate è chiaro che se y, y' sono le ordinate degli stessi punti P e Q, si ha

$$PQ = \sqrt{(x'-x)^2 + (y'-y)^2 + 2c(x'-x)(y'-y)}:$$

d' altronde essendo i punti P e Q sulla retta BQ risulta

$$y = ax + b, \; y' = ax' + b$$

donde $y' - y = a(x' - x)$, il quale valore sostituito in quello di PQ dà immediatamente l' equazione (3). Avendosi pure $x' - x = \frac{y'-y}{a}$ è evidente che la detta distanza può essere espressa dalla formola

$$\frac{y'-y}{a}\sqrt{1 + a^2 + 2ca}.$$

(**) Per brevità in vece di dire il punto che ha per coordinate t ed u, diremo sempre il punto t, u; ed è da notarsi che nomineremo prima l' ascissa, e poi l' ordinata.

ed eliminando u^2 dalle due equazioni precedenti risulta

$$(t + 2d')(\beta u + pt - \beta^2 - 2p\alpha) + d'(\beta^2 + 2p\alpha) = 0 \ldots . (4),$$

e la curva espressa da questa equazione, che come è chiaro è una iperbola, incontra la parabola ne' punti M.

2. Per costruire questa curva osserviamo che mancando il termine in u^2 uno degli asintoti è parallelo all' asse delle y, quindi cambiando l' origine e il solo asse delle ascisse, si potrebbe determinare la vera posizione degli asintoti; ma sarà più breve determinarli osservando che se immaginiamo due rette date dall'equazioni

$$t + 2d' = \gamma, \; \beta u + pt - \beta^2 - 2p\alpha = \gamma'$$

γ e γ' essendo due costanti qualunque, combinando queste equazioni con quella della curva ne risulta un' equazione di primo grado, e che per conseguenza le rette suddette incontrando la curva in un sol punto sono parallele agli asintoti; e poichè quando $\gamma = o$, o $\gamma' = o$ il punto d' incontro si trova a distanza infinita dall' origine, saranno

$$t + 2d' = o, \quad \beta u + pt - \beta^2 - 2p\alpha = o$$

l' equazioni degli asintoti. Queste equazioni si costruiscono colla massima facilità. Difatti dall' equazione (3), ponendo $x = o$, $x' = -2d'$, si rileva che la retta espressa dall' equazione

$$t = -2d'$$

taglia sulla BQ una parte uguale a

$$-2d' \sqrt{1 + a^2 + 2ac} = -2d,$$

e che perciò se BC $= 2d$, la CO sarà un' asintoto: quanto all' altra equazione si ponga $u = o$, e si avrà $t = \frac{\beta^2 + 2p\alpha}{p}$; ma nell' equazione (1') ponendo $u = o$, si ha $t = \text{AI} = \frac{\beta^2 + 2p\alpha}{2p}$, dunque presa IG = IA, per G passerà l'asintoto, e poichè la tangente IH ha per equazione $2\beta u + 2pt = \beta^2 + 2p\alpha$, sarà ad IH parallelo. Assegnati in tal modo gli asintoti, resta a trovare un punto dell' iperbola, a fine di descriverla; ora avendosi dall' equazione (4) per $t = o$, $2\beta u + 2pt = \beta^2 + 2p\alpha$, sarà H questo punto, e resterà così tutto determinato.

Composizione del problema.

Fatto l'angolo xAR uguale al dato: si prenda IG uguale ad IA. BC uguale alla retta data, e si tiri alla tangente IH la parallela GO. L'iperbola che passando per H ha per asintoti OC ed OR incontra la parabola ne' punti cercati.

3. Siccome nel prendere la distanza PQ potevasi adottare il segno $\pm$ avanti il radicale dell' equazione (3), anche la d' nell' equazione (4) potrebbe essere affetta dal segno $\pm$, lo che cambia soltanto la direzione della CO che invece di passare per C, quando si prendesse il segno $-$ passerebbe per C': quindi pare che risolvendo il problema due iperbole differenti, ne sieno otto le soluzioni; ma è chiaro che di queste iperbole una passa pe' punti M l'altra pe' punti N. Difatti allorchè tra l' equazioni (1) e (2) abbiamo eliminata la y, l'equazione ottenuta in x, non considerando il punto t, u appartenente alla parabola, ci dimostra che

$$\frac{2t\sqrt{p^2t^2 + 2p\beta ut - 2p\alpha u^2}}{u^2}$$

è la differenza delle ascisse; t, u essendo le coordinate di un punto qualunque della AMN, e quindi dovrà essere

$$\frac{t\sqrt{p^2t^2 + 2p\beta ut - 2p\alpha u^2}}{u^2} = d' \ldots (1).$$

Questa equazione essendo liberata dal radicale e divisa per t^4 si riduce ad un' equazione di quarto grado rispetto ad $\frac{u}{t}$: quindi darà quattro valori per $\frac{u}{t}$, e sostituendoli nell' equazione (2) del n. 1 si conosceranno le quattro posizioni, che algebricamente parlando, può avere la AMN: or avendosi dalla detta equazione $\frac{y}{x} - \frac{u}{t} = o$, è chiaro che moltiplicando le quattro equazioni che si ottengono nel modo or indicato, si otterrà un' equazione che differisce dalla (1) pel solo cambiamento di x, y in t, u, e quindi se si cercasse di costruire l' equazione (1), invece di una linea del quarto ordine si avrebbero quattro rette. Ed è da notarsi, che in generale qualunque sia il grado di un' equazione fra due variabili, purchè sia omogenea rappresenta sempre tante rette che passano per l' origine per quanto è il numero che ne indica il grado. Pertanto volendo costruire le rette date dall'equazione (1), possiamo cercare ove incontrano una data retta, e le ascisse o le ordinate de' punti d'incontro verranno date da un' equazione di quarto grado, che si potrà come è noto costruire adoprando la stessa parabola data ed il cerchio. Prendiamo per la retta arbitraria quella espressa dall'equazione

$$u = \frac{2cp^2}{\beta},$$

l'equazione trovata più sopra diverrà

$$t^2\left(t^2+4cpt-\frac{8c^3\alpha p^3}{\beta^4}\right)=\frac{16c^4p^6d'^2}{\beta^4},$$

e ponendo

$$t^2=2pu\ldots\ldots\ldots\ (2);$$

avremo l' equazione

$$u^2+2c\,ut-\frac{4c^3\alpha p^3}{\beta^4}\,u=\frac{4c^4p^4d'^2}{\beta^4},$$

che sommata colla precedente dà

$$u^2+2\,cut+t^2-2\left(p+\frac{2c^2\alpha p^2}{\beta^2}\right)u=\frac{4c^4p^4d'^2}{\beta^4}\ \ldots\ldots\ (3)$$

equazione appartenente ad un cerchio. Ma la (2) indica la parabola data se prendiamo Dt per asse delle t, e Du per asse delle u; dunque rispetto a' medesimi assi dobbiamo costruire l' equazione (3). Ciò posto allorchè $u=o$ si ha dall'equazione (3) $t=\pm\frac{2c^2p^2d'}{\beta^2}$, e perciò se DT è questo valore per T deve passare il cerchio: inoltre è facile il rilevare dall' equazione del cerchio riferito a coordinate oblique, che il suo centro si determina prendendo su gli assi delle x e delle y due parti uguali alle metà de' coefficienti di x ed y a primo grado col segno cambiato, ed elevando agli assi medesimi due perpendicolari; onde essendo nullo nell' equazione (3) il coefficiente di t, presa ME $=p+\frac{2c^2\alpha p^2}{\beta^2}$, sarà F il centro (*). Quindi poichè il cerchio che ha F per centro e passa per T nel caso indicato dalla figura incontra la parabola in due soli punti, i valori di t saranno due reali e due immaginari; de' primi poi DL è positivo, DL' negativo, e per conseguenza se dl è la retta dell' equazione $u=\frac{2cp^2}{\beta}$, bisognerà prendere $dl=$ DL, e $dl'=$ DL', e le rette Al, Al' saranno le rette cercate.

(*) Possiamo anche assicurarci diversamente che F è il centro del cerchio appartenente all' equazione (3), difatti essendo $t=\pm\frac{2c^2p^2d'}{\beta^2}$ il cerchio dovrà passare anche pel punto T' posto alla stessa distanza di T da D, e la DF perpendicolare alla corda TT' nel suo punto di mezzo deve passare pel centro: del pari mettendo $t=o$ nell' equazione (2) si ha

$$u^2-2\left(p+\frac{2c^2\alpha p^2}{\beta^2}\right)u=\frac{4c^4p^4d'^2}{\beta^4};$$

ed i valori di u sono le ascisse de' punti ove la Du incontra il cerchio, e poichè la quantità $p+\frac{2c^2\alpha p^2}{\beta^2}$ è la semisomma delle radici di questa equazione, indicherà essa l'ascissa del punto di mezzo della corda intercetta nel cerchio, e quindi la EF anche passa pel centro.

Resta ora a vedere come debbansi costruire i valori di DE, DT, ed Ad: a tale oggetto si rifletta che dall' equazione (1, 1) (*) si rileva che la tangente applicata alla parabola in un punto qualunque α', β'; ha per equazione rispetto agli assi Ax, AR

$$y-\beta'=\frac{p}{\beta'-\beta}(x-\alpha');$$

onde se vogliamo che questa retta sia perpendicolare ad Ax, cioè che il punto α', β' sia il vertice principale, dovendo essere

$$\frac{p}{\beta'-\beta}=-\frac{1}{c},$$

si ha

$$\beta'-\beta=-\,cp,\ \text{e quindi}\ \alpha'-\alpha=\frac{c^2p}{2}.$$

Siegue da ciò che se I' è il vertice principale della parabola I'S' $=\frac{c^2p}{2}$, ed essendo $\beta^2=2p$. SI, sarà

$$\text{DE}=p+\frac{2c^2\alpha p^2}{\beta^2}=p+\frac{2\,\text{I'S'}.\alpha}{\text{SI}},$$

cioè uguale al semiparametro più la quarta proporzionale dopo SI, I'S' ed il doppio di AS. Similmente avremo DT $=\frac{2c^2p^2d'}{\beta^2}=\frac{2d'.\text{S'I'}}{\text{SI}}$; cioè quarta proporzionale in ordine ad SI, S'I', ed Ac: finalmente essendo la A$d=\frac{2cp^2}{\beta}=\frac{cp\beta}{\text{SI}}=\frac{\beta.\text{DS'}}{\text{SI}}$, si potrà ugualmente costruire, e si vede che la costruzione non cessa di essere sufficientemente semplice; e quindi è da preferirsi alla precedente, perchè non si adopra altra curva da descriversi per assegnazione di punti oltre della parabola data.

(*) A questo modo intendiamo indicare l'equazione (1) trovata nel §. 1, e si noti che porremo sempre prima il numero che dinota l' equazione, poi il numero del paragrafo nel quale si trova.

4. Ritornando ora alla soluzione data nel n.° 2 è da notarsi che quando $\beta = o$ l'equazione della IH divenendo $2pt = \beta^2 + 2p\alpha$, ci dimostra che è parallela ad AR, e che il punto H è inassegnabile; ma in questa medesima ipotesi l'equazione (4,1) si cangia nell'altra

$$t^2 - 2(\alpha - d')t - 2\alpha d' = o$$

ovvero

$$t = \alpha - d' \pm \sqrt{\alpha^2 + d'^2}$$

e si vede che l'iperbola si trasforma in due rette parallele ad AR: essendo $AC = 2d'$ apparisce come si possa in questo caso costruire facilmente l'equazione trovata (*).

Merita particolare attenzione il caso nel quale AR fosse un diametro della parabola, cioè l'angolo dato uguale a zero, perchè gli assi coordinati che abbiamo adottati si ridurrebbero ad un solo: ma prendendo per assi il diametro AIx (fig. 2), e la parallela Ay alla tangente applicata alla parabola in I, l'equazioni (1) e (2) del n. 1 diverranno

$$y^2 = 2p(x - \alpha) \ldots\ldots (1),\ y = \frac{u}{t}x \ldots\ldots (2),$$

ed eliminando x si ottiene

$$y^2 - \frac{2pt}{u}y + 2p\alpha = o.$$

(*) I valori di t indicando le ascisse de' punti M, le ascisse de' punti N che abbiamo veduto (n. 1) essere uguali a $\frac{2(\beta ut + pt^2)}{u^2} - t$, ovvero, nella presente ipotesi, a $\frac{2pt^2}{u^2} - t = \frac{\alpha t}{t - \alpha}$, saranno indicate da

$$\frac{\alpha - d' \pm \sqrt{\alpha^2 + d'^2}}{-d' \pm \sqrt{\alpha^2 + d'^2}} - \alpha = \frac{\alpha^2}{-d' \pm \sqrt{\alpha^2 + d'^2}} + \alpha = \alpha + d' \pm \sqrt{\alpha^2 + d'^2},$$

lo che dovea aspettarsi per ciò che si è detto nel n. 2, che cioè, quando si prende d' col segno — la linea espressa dall'equazione (4, 1) passa pe' punti N.

Or essendo u una radice di questa equazione, l'altra sarà $\frac{2pt}{u} - u$, ma le ordinate de' punti P e Q sono uguali a quelle de' punti M ed N, dunque u, e $\frac{2pt}{u} - u$ sono le ordinate de' detti punti: quindi, poichè supponendo sempre che

$$y = ax + b$$

sia l'equazione della BQ si rileva che dette y, y' le ordinate di due suoi punti, la loro distanza è espressa da

$$\frac{y' - y}{a}\sqrt{1 + a^2 + 2ac},$$

avremo l'equazione

$$\left(\frac{2pt}{u} - 2u\right)\frac{\sqrt{1 + a^2 + 2ac}}{a} = 2d,$$

ovvero, ponendo per brevità

$$\frac{ad}{\sqrt{1 + a^2 + 2ac}} = d',$$

$$\frac{pt}{u} - u = d',$$

donde, tenendo presente che

$$u^2 = 2p(t - \alpha) \ldots\ (1'),$$

si ricava

$$pt + d'u - 2p\alpha = o:$$

equazione appartenente ad una retta.

Questa si costruisce facilmente poichè quando $u = o$ avendosi $t = 2\alpha$, si vede che presa $IE = IA$ la retta passa per E; inoltre quando $u = -d'$ risulta $t = \frac{2p\alpha + d'^2}{p}$; ma dall'equazione (1') per $u = -d'$ si ha $t = \frac{2p\alpha + d'^2}{2p}$; dunque poichè l'equazione $u = -d'$ indica la parallela all'asse delle x condotta pel punto di mezzo della BC, che è la data retta $2d$; ne siegue che presa $DF = DH$ il punto F anche appartiene alla retta da costruirsi, che sarà in conseguenza la FE, ed i punti M, M' uniti con A daranno le rette cercate.

5. Dall'equazione della MM' si rileva che è parallela alla tangente in D, e poichè $HD = DF$ le congiungenti i punti M, M' con H saranno tangenti alla parabola: inoltre quando si prende $-d'$ in luogo di d' si determinano, come già si è dimostrato, i punti N, N', dunque presa $AH' = AH$ le rette che uniscono i punti N, N' con H' sono anche tangenti alla parabola, e perciò

Se per un punto A di un diametro qualunque Ax si tiri una parallela alla tangente in I, condotte per un punto H di questa parallela due tangenti alla parabola, le congiungenti i punti di contatto M, M' con A incontrano la parabola in due punti N, N' tali, che le tangenti applicate in essi alla parabola s' incontrano in un punto H' della AH distante da A quanto il punto H.

Dippiù nell' equazione

$$pt \mp d' u - 2p\alpha = o$$

che appartiene alle MM', NN', ponendo $u = o$, si ha $t = 2\alpha$, e quindi queste rette concorrono in uno stesso punto E del diametro Ax. Avendo trovato che u essendo l' ordinata del punto M, $\frac{2pt}{u} - u$ è quella del punto N, il loro rettangolo sarà $2pt - u^2 = 2p\alpha$, cioè uguale al quadrato dell' ordinata che passa per E: similmente rilevandosi dall' equazione (2, 4) che t e $\frac{2pt^2}{u^2} - t = \alpha + \frac{\alpha^2}{t-\alpha}$, sono le ascisse de' punti M, N si vede che le loro ascisse rispetto al punto I sono $t - \alpha$ ed $\frac{\alpha^2}{t-\alpha}$, onde il loro rettangolo è uguale al quadrato di AI; e quindi ne siegue che

Quando una retta seca una parabola, il rettangolo delle ordinate de' punti d' incontro rispetto ad un diametro qualunque, è uguale al quadrato dell' ordinata condotta pel punto ove la secante incontra il diametro, o per un punto dèl diametro ugualmente lontano dal vertice, se il primo è fuori la parabola. Ed il rettangolo delle ascisse degli stessi punti, computate dal vertice, uguaglia il quadrato della parte del diametro intercetta fra il vertice e la secante.

Questi ed altri teoremi potrebbero ricavarsi combinando direttamente l' equazioni della parabola e di una retta qualunque.

6. Dobbiamo ancora avvertire che l' andamento tenuto nel n. 2 per costruire gli asintoti dell' iperbola espressa dall' equazione (4, 1) si può seguire in tutti i casi. Difatti sia

$$ay^2 + bxy + cx^2 + dy + ex + f = o$$

un' equazione qualunque di secondo grado, e sieno i coefficienti a, b, c tali che i primi tre termini possansi decomporre in fattori reali di primo grado, talchè l' equazione possa mettersi sotto la forma

$$(my + nx)(m'y + n'x) + dy + ex + f = o,$$

è chiaro che combinando l' equazione

$$my + nx = \gamma, \text{ ovvero } m'y + n'x = \gamma'$$

con la precedente si ottiene un equazione di primo grado, e perciò le rette espresse da queste equazioni incontrano la curva in un sol punto, cioè sono parallele agli asintoti: che se determineremo γ, γ' in modo che il punto d' incontro sia situato ad una distanza infinita dall' origine, lo che avviene, come è chiaro, quando

$$\frac{\gamma m' + d}{\gamma n' + e} = \frac{m}{n}, \quad \text{e} \quad \frac{\gamma' m + d}{\gamma' n + e} = \frac{m'}{n'},$$

le rette indicate dall' equazioni precedenti apparterranno agli asintoti. Ugualmente se i coefficienti a, b, c sono tali che i primi tre termini formano un quadrato perfetto, l' equazione riducendosi alla forma

$$a(y + mx)^2 + dy + ex + f = o,$$

si vede che ogni retta parallela a quella data dall' equazione

$$y + mx = o,$$

incontra la curva in un sol punto, e perciò questa retta è diametro della curva, che è evidentemente una parabola, e quindi se trovato il punto ove incontra la curva, si cerca la posizione della tangente in quel punto per mezzo della data equazione, non resta più che ad assegnare un punto della curva affinchè possa descriversi. Questo modo di costruire una equazione di secondo grado quando appartiene all' iperbola o alla parabola ha, almeno in quanto alla brevità, un vantaggio su' metodi che trovansi esposti ne' corsi di geometria a due coordinate fondati sulla permutazione delle coordinate, e perciò crediamo che possa utilmente seguirsi nella maggior parte de' casi, e noi ne daremo delle continue applicazioni. Non sarà pertanto inutile di fare osservare che il trinomio $ay^2 + bxy + cx^2$ si può decomporre in fattori di primo grado e reali quando $b^2 > 4ac$, ed è un quadrato perfetto se $b^2 = 4ac$, che sono le note relazioni che passar devono fra i coefficienti a, b, c onde l' equazione esprima l' iperbola o la parabola.

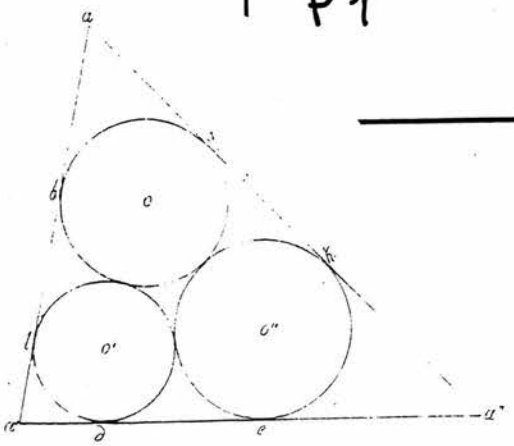
Appendix 2

QUESITO 2.°

PROBLEMA

P1

Iscrivere in un triangolo dato di specie e di grandezza tre cerchi, che si tocchino tra loro, e tocchino due a due i lati del triangolo.



ANAL. — Sia $a\,a'a''$ il triangolo dato, e vi si suppongano * iscritti i tre cerchi come si è richiesto. Se vi fosse un altro triangolo simile al proposto, che tenesse in se iscritti tre cerchi come quelli, che si cerca di iscrivere nel primo, il problema sarebbe immantinenti risoluto. Quindi assumendo un * angolo A'AA'' eguale ad uno dei tre angoli del triangolo dato, per esempio ad a, ed iscrivendo in esso un cerchio BQH di qualsisia grandezza, il problema si convertirà nell' altro: di iscrivere due altri cerchi LCD, C'KE per modo che si tocchino tra loro, tocchino il cerchio BQH, e i lati dell' angolo, e tali che la loro tangente comune DE sia parallela a qualunque retta che compia coll' angolo A un triangolo equiangolo ad $aa'a''$.

* f.1.n.1.

* f.1.n.2.

Premetteremo alla soluzione di questo problema i seguenti lemmi.

Lemma 1.°

L1

* fig. 2.

Sia BL tangente comune di due cerchi, che si toccano, e QY una secante distesa pel contatto C, dico: I°, che l' angolo QGY risultante dall' incontro delle corde BQ, LY sia retto: II°, e che GC sia perpendicolare a QY.

DL1

DIM. — Si unisca LC, e si distenda in H. Essendo i raggi OB, OH paralleli ad O'L, staran tra loro per dritto; e quindi l' angolo HQB sarà retto: ma per ragione del contatto C è QH parallela ad LY; dunque anche l' angolo QGY sarà retto.

II.° Risultando parimenti retto l' angolo BCL, i quattro punti B, C, L, G staranno alla circonferenza di un cerchio, e per le note proprietà di questa curva si avrà l' angolo BCG = BLG = YLA' = YCL. In conseguenza l' angolo BCL sarà eguale all' angolo GCY, e questo retto al par di quello, com' erasi proposto a dimostrare.

Lemma 2.

L2

* fig. 3.

Due cerchi O, O' sien toccati da un terzo cerchio in C', C'', e da una retta in B, L, le corde BC', LC'' concorreranno in un punto X sulla circonferenza del terzo cerchio.

DL2

DIM. — La BC' si distenda in X; sarà il raggio XO'' parallelo ad OB, e quindi ad O'L: sicchè LC'' passerà benanche per X.

Corollario 1.°

C1

Quindi le tangenti ne' punti X, X' saran parallele a BL.

C2

Corollario 2.°

Suppongasi, che anche i cerchi O, O′ si tocchino tra loro in C, dovrà la congiungente XC risultare tangente comune a' cerchi medesimi; ed in vero se si produca la C′C″ in Z, avendosi l' angolo XC′C″ = LZC″ = BLX, i triangoli XC′C″, XLB saranno simili, e si avrà BX.XC′ = LX.XC′. Ma il primo rettangolo è quanto la differenza de' quadrati di OX, OC, e l' altro è quanto la differenza de' quadrati di O′X, O′C: adunque queste differenze saranno uguali; e risultando perciò XC perpendicolare ad OO′, dovrà toccare nel punto C l' uno e l'altro cerchio O, O′. * fig. 4.

C3

Corollario 3.

È chiaro adunque che la CX sia il luogo de' punti da' quali condotte le tangenti a' cerchi O, O′, queste risultano eguali tra loro. Di più se la stessa CX si produca fino ad S sulla BL, dovrà bisecarla, risultando ciascuna delle SB, SL uguale ad SC.

L3

Lemma 3.°

Sia G il punto, in cui s' incontrano due corde BQ, NC, di un cerchio, ed U, S i concorsi delle tangenti nelle loro estremità: i tre punti G, U, S staranno per dritto. * fig. 5.

DL3.

Dim.—Si producano in A le tangenti de' punti B, Q, e si tirino le UP, UR parallele alle SQ, SC. Essendo AB = AQ, sarà UB = UP; similmente si mostrerà UN = UR: e dall' essere UB = UN, si conchiuderà UP = UR; ma queste sono respettivamente parallele alle SQ, SC, che son del pari eguali tra loro, adunque le QC, PR saranno parallele; e la loro ragione risultando eguale tanto a quella di QG a GP, quanto all' altra di QS a PU, queste ragioni saranno eguali; e perciò i tre punti G, U, S staranno per dritto.

C4

Corollario.

* fig. 6. Se la conginngente de' punti Q, C fosse un diametro del cerchio, le tangenti QS, CS risulterebbero parallele, ed in tal caso la UG diverrebbe parallela alle tangenti medesime.

L4

Lemma 4.

* fig. 7. *Sia BQHI un rettangolo iscritto in un cerchio, ed NM un diametro parallelo ad uno dei suoi lati BQ. Da qualunque punto G di questo lato cadan, passando per N, ed I le secanti GNC′, GIC, le corde C′H, CM s' incontreranno in un punto F su'quel lato medesimo.*

DL4

Dim.—Sieno d, t, e i punti di concorso delle tangenti in
* lem. 3. N, I; C, C′; H, M; i punti G, d, t staran per dritto *.
Ciò posto sia K il punto, in cui s' incontrano le corde MC,
* cor. prec. NC′, dovrà risultare tK parallela alle Nd, Me *. Si avrà quindi Kt : Nd :: KG : GN; ma se si prolunghi KM in F si ha KG : GN :: KF : FM; starà dunque KF : FM :: Kt : Nd, ovvero :: Kt : Me; per esser Nd = Me. E però dovendo la te
* lem. 3. passare pel punto F *, la C′H passerà benanche pel punto istesso; il che dovea dimostarsi.

C5

Corollario.

È chiaro che se il punto G cada fuori del cerchio, debba anche il punto F caderne al di fuori, mentre i punti C,C′ debbono cadere sull' arco ICH. Se poi il punto G stia dentro del cerchio *, i punti C, C′ dovran trovarsi sull' arco BPQ, e quindi anche F starà dentro del cerchio. * fig. 8

Avvertimento.

Il punto F, la di cui posizione dipende dal sito di G, sarà chiamato in seguito per brevità *punto di concorso corrispondente al punto G*.

P2

PROBLEMA.

Dato il cerchio BQH iscritto in un dato angolo A, descrivere due altri cerchi, che si tocchino tra loro, tocchino il cerchio dato, e i lati dell' angolo, e tali che la loro tangente comune formi coll' angolo A un triangolo equiangolo al dato triangolo a′aa″ (*). f.1.n.2.

A2

Anal.—Sieno O′, O″ i centri de' cerchi cercati, che si tocchino tra loro in C″, tocchino in C, C′ il dato cerchio, in L, K i lati dell' angolo, ed abbiano una tangente comune DE, che formi coll' angolo A il triangolo A′AA″ equiangolo ad a′aa″. Si uniscano le DC, EC′; queste dovranno incontrarsi in un punto P sulla circonferenza del cerchio O *; e poichè la tangente in P risultar dee parallela a DE *, il punto P sarà dato. Dovendo inoltre le corde PB, DL incontrarsi ad angolo retto in un punto T, ed esser TC perpendicolare a PD *, si avrà $DP.PC = PT^2$. Similmente si vedrà risultare $EP.PC' = PV^2$; e per essere $DP.PC = EP.PC'$ *, si conchiuderà $PT^2 = PV^2$; ossia $PT = PV$.

* lem. 2.
* c.1.l.2.
* lem. 1.
* c.2.l.2.

Di più si unisca LC, e si distenda in H. Essendo retto l' angolo BCL, e quindi anche il suo conseguente BCH; il punto H sarà dato, per esser dato il punto B. E così, congiungendo KC′, e prolungandola in I, questo punto sarà dato per esser dato il punto Q.

Ciò premesso anche le corde QC, KC″ dovranno incontrarsi nel punto Y sulla circonferenza LCD; la YC′ dovrà toccare i due cerchi O, O″ nel punto C′, e si avrà $QY.YC = YC'^2$. Or dovendo le corde QB, YL incontrarsi ad angolo retto, e risultar GC perpendicolare a QY*, essa dovrà passare pel dato punto I; e si avrà $QY.YC = YG^2$. Sarà quindi $YG = YC'$. Ma se uniscasi GC′, e pel punto N ove incontra il cerchio si tiri la tangente NR, l' è anche $NR = RC'$; sarà dunque NR parallela a GY, e perciò il diametro, che passa per N sarà parallelo a BQ. Vale a dire il punto N sarà dato. In egual modo, per essere retto l' angolo BFX, ed FC′ perpendicolare a BX si vedrà che FC′ debba passare pel dato punto H; e si vedrà inoltre, che la FC debba incontrare il cerchio O nel

* lem. 1.

(*) È da notarsi, che questo problema di conversione ammette diverse ipotesi, e quindi diverse soluzioni. Nella presente si suppone, che i due cerchi si tocchino al di sotto di BQH, e si considera la loro tangente comune inferiore, ciò corrispondendo al problema proposto; ma potrebbe anche supporsi, che i due cerchi fossero superiori al cerchio BQH *; potrebbero ancora considerarsi nell' un caso, e nell' altro le tangenti superiori *; considerarsi del pari le tangenti trasversali *; e così far altre supposizioni. Di che sarà detto altrove. * fig. 10. * f.11.e 12. * fig. 13.

A 2

dato punto M, estremo del diametro parallelo a BQ, ch' è lo stesso diametro che passa per N.

Intanto è chiaro, che la figura BQIII sia un rettangolo iscritto nel cerchio O, il cui diametro NM è parallelo a BQ: in conseguenza essendosi dal punto G tirate per I, N le secanti GIC, GNC′, e poscia le CMF, C′IIF, *il punto F sarà il punto di concorso corrispondente al punto G* *. Ma si è preveduto, che debba essere PT = PV, retti gli angoli PTL, PVK, e che sia dato il punto P; adunque la quistione è ricondotta alla soluzione di quest' altro *avv.prec.

P 3

PROBLEMA.

Trovare sulla BQ un punto G tale, che elevate su di essa da G, e dal suo corrispondente punto di concorso F le perpendicolari GL, FK; ed abbassate poi le LT, KV perpendicolari alle corde PB, PQ, risulti PT = PV. * fig. 9.

A 3

ANAL. Supponghasi rinvenuto il punto G, come si è detto, e sia C′S tangente in C′; questa bisecherà la QK*. Si applichi poi al punto N la tangente NU, e si conduca UY parallela a QS. Dovendo star per dritto i punti G, U, S *, si avrà QG : GY :: SQ : UY, ovvero, presa QX = 2.UY, :: QK : QX, oppure, tirata XR parallela a KV, :: QV : QR. Adunque, dividendo, avremo QY : GY :: RV : RQ. Ciò posto si taglino le Pq, qr eguali alle PQ, QR; dovendo essere PT = PV, risulterà Tr = VR; e quindi starà QY : GY :: Tr : rq, ovvero :: Gm : mn, tirando le qn, rm parallele a GT. Sicchè si avrà QY × mn = GY × Gm.
* c.3.l.2.
* lem. 3.

Intanto essendo retti gli angoli BGL, BTL, i quattro punti B, G, T, L staranno alla circonferenza di un cerchio; e perciò si avrà l' angolo TGL = TBL = BIP. Essendo dunque GL parallela a BI, sarà GT parallela a PI; e però le rette rm, qn, essendo dati i punti m, n, saranno date di sito. Quindi mn sarà data di grandezza; e con ciò, essendo data QY, sarà dato il rettangolo di GY in Gm. In conseguenza sarà pur dato il punto G, e 'l problema avrà la seguente

S

COMPOSIZIONE.

Segnato il diametro NM parallelo a BQ, la tangente NU, e l' altra in P, che formi coll' angolo A un triangolo equiangolo ad $a'aa''$, si conduca UY parallela ad AQ. Indi presa QX doppia di UY, ed abbassata XR perpendicolare a PQ, si taglino le Pq, qr eguali alle PQ, QR. Finalmente tirate le qn, rm parallele a PI, si rinvenga il punto G tale che sia GY × Gm = QY × mn. Sarà G il punto cercato.

* f.1. n.2. Rinvenuto questo punto si tireranno le GIC, GNC′; quindi le IICL, IC′K, ed inoltre le LT, KV perpendicolari alle PB, PQ, che si produrranno finchè incontrino in D, E le PC, PC′.

I cerchi descritti intorno ai triangoli CLD, C′KE si toccheranno tra loro, toccheranno il cerchio BQII, ed i lati dell' angolo A, ed avranno per tangente comune la DE, che formerà coll' angolo stesso il triangolo A′AA″ equiangolo al dato triangolo $a'aa''$; e dovendo essere tutte le parti della figura compresa dal triangolo A′AA″ proporzionali alle parti della figura simile, che verrebbe ad esser contenuta dal triangolo $a'aa''$ colla iscrizione de' tre cerchi, che si sono richiesti, il problema principale rimane risoluto.

Appendix 3

PROBLEMA II.

5. *Iscrivere* (Fig. 3.) *in un triangolo tre cerchi, in modo che ciascuno tocchi gli altri due, e due lati del triangolo.*

Sieno AA'A'' il triangolo dato, M, M', M'' i centri de' cerchi cercati. Dovendo questi cerchi toccare rispettivamente i lati AA', AA''; AA', A'A''; A'A'', AA'', le rette AM, A'M', A''M'' divideranno gli angoli del triangolo per metà, e concorreranno per conseguenza in uno stesso punto O, centro del cerchio iscritto nel triangolo.

Ciò posto si prendano per assi la AA' e la Ay ad essa perpendicolare, e si chiamino α, β le coordinate del punto O: $\alpha+\alpha'$ l'ascissa del punto A'; t, u; t', u' le coordinate de' punti M, M'. Osservando che u, u' sono i raggi de' cerchi aventi M, M' per centri, si otterrà l'equazione

$$(t'-t)^2+(u'-u)^2=(u'\pm u)^2,$$

ovvero

$$t'-t=\pm 2\sqrt{uu'},\quad t'-t=0,$$

secondochè nell' equazione precedente si dà ad u il segno + o il segno —. Ma essendo i punti M, M' su le rette OA, OA', abbiamo

$$u=\frac{\beta}{\alpha}t,\quad u'=-\frac{\beta}{\alpha'}(t'-\alpha-\alpha'),$$

dunque le equazioni trovate poc' anzi si ridurranno ad

$$\alpha u+\alpha'u'\pm 2\beta\sqrt{uu'}=\beta(\alpha+\alpha'),\quad \alpha u+\alpha'u'=\beta(\alpha+\alpha')\dots\ (1).$$

Similmente, se indichiamo con u'' il raggio del cerchio che ha per centro M'', e con $\alpha+\alpha''$ la AA'', essendo per conseguenza $A'A''=\alpha'+\alpha''$, avremo le altre due coppie di equazioni

$$\alpha u+\alpha''u''\pm 2\beta\sqrt{uu''}=\beta(\alpha+\alpha''),\quad \alpha u+\alpha''u''=\beta(\alpha+\alpha'')\dots\ (2).$$
$$\alpha'u'+\alpha''u''\pm 2\beta\sqrt{u'u''}=\beta(\alpha'+\alpha''),\quad \alpha'u'+\alpha''u''=\beta(\alpha'+\alpha'')\dots\ (3).$$

Espresse in tal guisa algebricamente tutte le condizioni del problema, non resta che a ricavare da tre di queste equazioni, combinate in tutti i modi possibili, purchè non si prendano nello stesso tempo le due equazioni (1), o le (2), o le (3), i valori di u, u', u''. Dalla diversa combinazione delle suddette equazioni si otterranno le varie soluzioni del problema proposto, la discussione delle quali volendo ora intraprendere, cominceremo dal considerare nelle equazioni (1), (2), (3) le sole prime, ed i radicali in esse esistenti col segno +, potendosi anche questi segni prendere in diversi modi. Ciò posto dovendo, per risolvere le accennate equazioni, eliminarne i radicali, seguendo le norme generali dateci dall' Algebra, porremo

$$2\sqrt{uu'}=x'',\quad 2\sqrt{uu''}=x',\quad 2\sqrt{u'u''}=x,$$

ove per x, x', x'' intendiamo le determinazioni aritmetiche di questi radicali, e perciò esse sono quantità essenzialmente positive. Da queste equazioni, si ha

$$u=\frac{x'x''}{2x},\quad u'=\frac{xx''}{2x'},\quad u''=\frac{xx'}{2x''},$$

e per conseguenza le equazioni in u, u', u'', diverranno

$$\alpha\frac{x'x''}{2x}+\alpha'\frac{xx''}{2x'}+\beta x''=\beta(\alpha+\alpha'),$$
$$\alpha\frac{x'x''}{2x}+\alpha''\frac{xx'}{2x''}+\beta x'=\beta(\alpha+\alpha''),$$
$$\alpha'\frac{xx''}{2x'}+\alpha''\frac{xx'}{2x''}+\beta x=\beta(\alpha'+\alpha'').$$

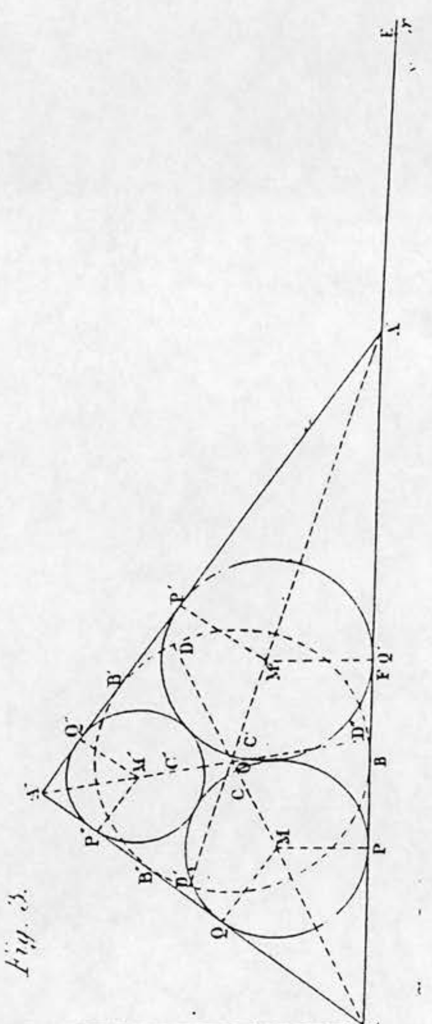


Fig. 3.

Ciascuna di queste equazioni liberata da rotti è di terzo grado, onde par che ne sia più difficile la soluzione, ma si può facilmente pervenire ad equazioni che non sorpassino il secondo grado. Di fatto sommando le prime due e togliendone la terza, si ottiene

$$x\,\frac{x'x''}{x}+\beta(x'+x''-x)=2\beta x\ldots(4),$$

e similmente si avranno le altre due

$$x'\,\frac{xx''}{x'}+\beta(x+x''-x')=2\beta x'\ldots(5),$$
$$x''\frac{xx'}{x''}+\beta(x+x'-x'')=2\beta x''\ldots(6).$$

Queste equazioni oltre all' essere di un' estrema simmetria, godono della proprietà che ciascuna contiene una soltanto delle tre quantità x, x', x''; ma è da osservarsi che non sono le sole che possono adempiere questa condizione; imperocchè essendo x'' la distanza che il punto A'' serba dalla perpendicolare abbassata sulla AA'' dal punto O, le quantità x, x', x'', β non sono indipendenti, essendo già determinato il punto A'' allorchè sono date x, x', β; e la relazione che passa fra esse, come è facile determinare, è

$$\beta^2=\frac{xx'x''}{x+x'+x''}\ldots\ldots\ldots\ldots(7).$$

Quindi, fra questa equazione e due delle equazioni trovate eliminando x, x'; x, x'', x', x'' successivamente, si otterranno altre equazioni fra x, x', x''; ciascuna delle quali non contiene che una delle tre quantità x, x', x''. Così prendendo dall' equazione (7) il valore di x'', si ha $x''=\frac{\beta^2(x+x')}{xx'-\beta^2}$, e sostituendolo nell'equazione (6), si ottiene

$$\beta(x+x')\frac{xx'}{x''}+(xx'-\beta^2)(x+x'-x'')=2\beta^2(x+x'),$$

la quale equazione, ordinata rispetto ad x', diviene

$$x'\left(\beta\,\frac{xx'}{x''}+x(x+x'-x'')-2\beta^2\right)=\beta\left(2\beta x+\beta(x+x'-x'')-x\,\frac{xx'}{x''}\right),$$

e poichè la (5) dà

$$\beta(x+x''-x')=x'\left(2\beta-\frac{xx''}{x'}\right),$$

eliminandone x', ne risulta

$$(x+x''-x')\left(\beta\,\frac{xx'}{x''}+x(x+x'-x'')-2\beta^2\right)$$
$$=\left(2\beta-\frac{xx''}{x'}\right)\left(2\beta x+\beta(x+x'-x'')-x\frac{xx'}{x''}\right).$$

Nello sviluppare quest' equazione che, come vedesi, contiene soltanto x, raccoglieremo i coefficienti di $\frac{xx'}{x''}$ ed $\frac{xx''}{x'}$, e, togliendo i termini che si distruggono, avremo

$$\left.\begin{array}{l}\left(2\beta x+\beta(x+x''-x')\right)\frac{xx'}{x''}+\left(2\beta x+\beta(x+x'-x'')\right)\frac{xx''}{x'}\\ \qquad -x(x'-x'')^2-4\beta^2x\end{array}\right\}=4\beta^2x\,;$$

ma in virtù dell' equazione (4) abbiamo

$$2\beta x+\beta(x+x''-x')=x\frac{x'x''}{x}+2\beta x'',$$
$$2\beta x+\beta(x+x'-x'')=x\frac{x'x''}{x}+2\beta x',$$

5

dunque, sostituendo questi valori nell' equazione precedente, e riducendo, conseguiremo

$$2\beta x x' + 2\beta x x'' + 2\alpha x' x'' - 4\beta^2 x = 4\beta^2 \alpha,$$

ovvero

$$x\left(\alpha \frac{x' x''}{x} + \beta(x' + x'') - 2\beta^2\right) = 2\beta^2 \alpha.$$

la quale equazione in virtù della (4) si riduce ad

$$x^2 - 2(\beta - \alpha)\, x = 2\beta\alpha,$$

equazione semplicissima, e che ci determina il valore di x. Similmente, attesa la simmetria delle equazioni (4), (5), (6), è chiaro che dovrà aversi

$$x'^2 - 2(\beta - \alpha')x' = 2\beta\alpha',$$
$$x''^2 - 2(\beta - \alpha'')x'' = 2\beta\alpha''.$$

Ricavando ora da queste equazioni i valori di x, x', x'', otterremo

$$x = \beta - \alpha + a, \ x' = \beta - \alpha' + a', \ x'' = \beta - \alpha'' + a''.$$

ove

$$a = \sqrt{\beta^2 + \alpha^2}, \ a' = \sqrt{\beta^2 + \alpha'^2}, \ a'' = \sqrt{\beta^2 + \alpha''^2}.$$

Nel risolvere le equazioni in x, x', x'' avremmo dovuto prendere i radicali, e quindi le quantità a, a', a'', col doppio segno $\pm$, ma come prendendo il segno $-$ risulterebbero negativi i valori delle ignote x, x', x'', e noi abbiamo già avvertito che queste erano quantità assolutamente positive, così abbiamo tralasciato il segno $-$: del resto non mancheremo in seguito di spiegare, a che corrisponderebbero questi valori negativi, ed in qual modo dovrebbero combinarsi. Trovati intanto i valori di x, x', x'', avremo immediatamente quelli di u, u', u''; infatti, tenendo presenti le equazioni (4), (5), (6), si otterrà

$$u = \frac{x' x''}{2x} = \frac{\beta}{2\alpha}(2\alpha + x - x' - x'') = \frac{\beta}{2\alpha}(\alpha + \alpha' + \alpha'' - \beta + a - a' - a''),$$
$$u' = \frac{x x''}{2x'} = \frac{\beta}{2\alpha'}(2\alpha' + x' - x - x'') = \frac{\beta}{2\alpha'}(\alpha + \alpha' + \alpha'' - \beta + a' - a - a''),$$
$$u'' = \frac{x x'}{2x''} = \frac{\beta}{2\alpha''}(2\alpha'' + x'' - x - x') = \frac{\beta}{2\alpha}(\alpha + \alpha' + \alpha'' - \beta + a'' - a - a').$$

Da' valori di x, x', x'' si rileva che due di queste quantità comunque prese sono maggiori della terza (*); e quindi i valori di u, u', u'' sono tutti minori di β, e per conseguenza essi esprimono i raggi de' tre cerchi cercati che trovansi iscritti nel triangolo. Dai medesimi valori, riflettendo essere $x'' = t' - t = PQ'$, $x' = QP''$, $x = P'Q''$, si deduce ancora che prese le rette AC, A'C', A''C'' rispettivamente uguali alle AB, A'B', A''B'', si avrà la PQ' uguale alla C''D'', la QP'' uguale alla C'D', e la P'Q'' uguale alla CD. Volendo intanto passare ad accennare quali costruzioni grafiche debbansi eseguire per la soluzione del presente problema, osserveremo che essendo $t = \frac{\alpha}{\beta} u$, si avrà

$$t = \tfrac{1}{2}(\alpha + \alpha' + \alpha'' - \beta + a - a' - a''),$$

e quindi immediatamente si rileva la seguente

Composizione del problema.

Iscritto nel triangolo AA'A'' il cerchio BB'B'', si prendano sulle A'O, A''O le A'C', A''C'' rispettivamente uguali alle A'B', A''B'', si prolunghi la AA' in E finchè sia la A'E uguale alla OA, e si tagli la EF uguale ad A'O più C''D''; indi condotta alla AF pel suo punto di mezzo la perpendicolare PM, si facciano le PQ', AP'' uguali rispettivamente alla C''D'', ed alla AP più C'D', e si elevino alle AA', AA'' le perpendicolari Q'M', M''P''. Saranno M, M', M'' i centri de' cerchi richiesti, ed MP, M'P', M''P'' i rispettivi raggi.

Appendix 4:

A Few Remarks on Early Modern Science in Naples

The mathematical "analysis" of the moderns (Cartesian analysis, and Leibnizian-Newtonian calculus later on) did not enjoy a great fortune in the Southern capital during the eighteenth century. Indeed, the history of the mathematical sciences in Naples during this period has been described as a gradual but inexorable "decline", the reasons of which are still debated[1]. By looking at the early debates over the introduction of Cartesian analysis and of calculus some hypothesis can be made about the nature of such a "decline".

The "modern party" (*novatores*) had its leader, in the second half of the seventeenth century, in Tommaso Cornelio (1617-1684), a physician and a mathematician who had been reading Galileo, Descartes and Gassendi from his university chair since 1653[2]. According to the historian Giannone[3], Cornelio introduced in Naples "the freedom of philosophizing" (*libertas philosophandi*), and he showed the fruitful conjunction of geometry and physics. A contemporary wrote about him: "He is a Cartesian, and great defender of the new things and, because of that, he is hated by those who swore faith to their masters [the scholastics]"[4]. However, Cornelio's suggestions entered a philosophical environment which was already lively and significantly autonomous from the rest of the peninsula. It was characterised by the tradition of the Southern "naturalism", that since Bernardino Telesio (1509-1588) and Giambattista della Porta (1535-1615) onwards had created the basis for an experimental approach to science which was alternative to that of the Galileian school. As Ugo Baldini emphasizes,

> the limits of this process [the introduction of modern science] resulted from the animistic tone of the notion of nature held in those circles [...]; the attribution of a sort of elementary psychism to matter made problematic the mathematisation of qualities, which according to Galileo and Descartes is the basis of the new science. It was the conceptual correspondent of the scarce presence of mathematics in the cultural and didactic structure of the Southern Italy, a strong differential trait with respect to the Central and the Northern parts of the country.[5]

Cornelio's main contribution was the conceptual re-shaping of some basic notion of the natural philosophy such as "matter" or "nature" in quantitative terms. Nevertheless, even in Cornelio and in those linked to him, "the extension of the mathematization of phenomena remained far from the one present in the Galileians"[6]. Cornelio was one of the founders of the *Accademia degli Investiganti* (1663), to whom belonged everyone willing to defend the ideas of the moderns in Naples, during the second half of the seventeenth century. The main goal of the academy was the introduction of the experimental method into natural philosophy. Among the academicians, *libertas philosophandi* became synonymous with a "plurality of philosophies", and of not being exclusively connected to any particular school. Also in 1663 Cornelio's *Progymnasmata physica* was published[7]. The place of publication, Venice, was symptomatic of the resistance faced by the Neapolitan moderns. The book contains the theorisation of sensorial experience and geometrical method as the only legitimate sources of scientific knowledge. Thanks to the activity of the academy, towards the end of the century there operated in Naples a restricted group of noteworthy geometers, such as Antonio Monforte (1644-1717) and Giacinto De Cristofaro (1650-?), who made the Neapolitan school of geometry "one of the more advanced in Italy"[8]. But, writing about the later professor Agostino Ariani (1672-1748), Amodeo remarks that "he converted many noble young men to the study of the mathematical sciences [...], and he eradicated the false opinion of the literati that Mathematics were *magic and dark arts* [Ariani started lecturing in 1695]"[9], which means that the 1680s campaign of the moderns had been restricted to a sort of cultural élite: there were few connections between these geometers, educated abroad, and the cultural reality of the Southern kingdom. During the following decades, Baldini remarks, because of certain basic "environmental limits", such as the lack of a connection between social forces and scientific production, the Neapolitan school of geometry slipped into a backward position, Bologna and Padua excelling Naples as mathematical centres. Baldini points out the connections between economics and mathematics: in Southern Italy certain disciplines strictly connected to advanced economies, such as hydraulic engineering, civil engineering and applied mechanics hardly existed. It is emblematic that, since the closure of the University of Messina (Sicily) in 1678, no chairs of mathematics were instituted in the South of Naples until 1750[10].

Why did mathematics decline in the Kingdom of Naples? The lack of technological applications of the new science is an important aspect of the question[11]. But this explanation needs further elaboration. Looking at the wider cultural panorama around 1700, one realises that it was heavily shaped by a crucial episode, the "trial against the atheists" (1688-1697), a most significant moment in the local *querelle des ancients and des moderns.* Some secondary figures from the professional middle-class were accused of atheism by the Inquisition, tried and arrested, the real target of the Inquisition being Cornelio's followers. During the process, the main theses defended by the moderns went under attack. The core of the matter was the doctrine of corpuscularism, that in those very years became the flag of the opposition to the political and ecclesiastical *status quo*. The moderns had always remained a restricted group, without powerful supporters and with few links with the local university, where they had to face a compact, powerful, conservative block, fiercely devoted to the defense of its corporate interests. The rupture with the traditional intelligentsia and authority was complete when it became clear that the strong sensationalism of the moderns could be easily turned into a form of full-blooded atomistic materialism. Furthermore, the methodological claim that "the principle of things has to be searched for in the things themselves" could be extended from the investigation of nature to that of man and society, and this alarmed the political and ecclesiastical authorities in Naples. The trial resulted in the prohibition of publishing any atomistic book (including Lucretius's poem). The posthumous attacks on Cornelio were the most visible aspects of the repression of the moderns, who were in the end turned into a sort of heretical sect. What is most interesting for our present purposes is the nature of the cultural reaction against the mathematising and quantitative science of the moderns. Let us consider a couple of well-known (at the time of their publication) works by members of the anti-modern side. In 1695, the erudite Matteo Egizio wrote a sceptical attack against modern science which was published under the title of *De scientiarum ambiguitate*. Here the modern argument of the empirical origin of scientific knowledge was accepted, but its conclusions were turned upside down: the empirical sciences, "invented by men", are unreliable "ut est humanae naturae miserrima conditio" [12]. Egizio also employed the term "libertas philosophandi" but to mean confusion, endless debate and vain disputes instead of anti-dogmatic pluralism. There is no progress in scientific knowledge: only a succession of discordant opinions[13]. Moreover the new science is damaging religious faith, and it supports the birth of heresies[14]. What Egizio proposed was, in the end, a reestablishment of the traditional hierarchy of knowledge. In the system of knowledge that he defended, sciences only need to be studied if they make the philosopher more "virtuous". But their place is definitely subordinate to metaphysical knowledge and to the revealed truths of religion. In particular, considering the case of mathematics, Egizio wrote that it has only to be studied enough for what "industrio Paterfamilias competit", and not as a "superstitioso Pythagorico"[15]. Mathematics can be useful, but it does not improve our *understanding* of the world. A second anti-modern work of some interest is by Niccolò Sersale, not a full-blooded reactionary as Egizio, but a member of a new scientific academy (the so-called "Accademia di Medinacoeli") founded in Naples in 1698, after the cultural normalization which followed the trial against the atheists. Sersale counterpoised the vanity of the human efforts to reach the truth by means of continued experiences and accurate reasoning (he almost quoted the famous words of Galileo), to the "only infallible truth of God and of His law"[16]. The two levels of human knowledge and divine knowledge are no longer autonomous and both legitimate (as in the Galileian metaphor of the "two books"); instead they are hierarchically ordered, with human knowledge in a subordinate position because of its being a consequence of original sin. The probabilistic character of knowledge is a negative limitation, an a priori impossibility of reaching any absolute truth, and the main reason for the spread of the "sects". The same revolutionary assertion by Galileo about *intensive* and *extensive* knowledge is rejected: truth and science simply lie on two different ontological plains. The very possibility of a progressive approximation to truth, which characterised the moderns, is decidedly rejected by Sersale. In the changing atmosphere of the turn of the century, the Neapolitan publisher Raillard, who had previously promoted the experimental philosophy of the moderns, published a book such as the *Apologetic Letters in Defense of Scholastic Theology and Peripatetic Philosophy*[17].

The discussion on the status of scientific knowledge penetrated deeply into the Neapolitan culture of the early eighteenth century. According to Eugenio Garin, it was "a real crisis of the scientific revolution"[18]. The fact that philosophers and historians such us Giambattista Vico and Pietro Giannone, entered the debate over the status of the sciences was a symptom of its centrality in Neapolitan culture. The main issue was the extension of the "geometric method" from physics to other areas of knowledge, like physiology, history or politics; i.e. the relation between mathematics and experience. The intellectual atmosphere in Naples was hostile to a quantitative conception of the sciences, as it clearly emerged in the influential writings of Vico[19] and in the more controversial work of Paolo Mattia Doria[20]. Galileo, according to Vico, was an acute geometer but not a deep metaphysician. And what he should have learned from metaphysics is that "things are not lines and numbers", they can't be explained a priori, *more geometrico*, but only by means of repeated experiences[21]. The main themes of Vico's writings book were to be extremely influential in the following decades: every science has a different methodology and a different status; every science needs a metaphysical foundation; the "geometrical method" has not to be improperly extended to empirical reality. The sciences of man and of history are not reducible to the study of the "human machine". The 1710 edition of Galileo's *Dialogo dei massimi sistemi*, has been seen as the extreme attempt to defend the now threatened *libertas philosophandi*, as "an appeal to what had remained of the *new science*, when doubts and critics were attacking it at the heart"[22].

The fact that in the same years mathematical sciences experienced a progressive decline can now be put in its cultural context. The "decadence" of mathematics, the elementary level of teaching in the university, and more generally the backwardness of scientific out-put from 1700 onwards can be seen as long-term consequences of an explicit *choice* taken by the generation of mathematicians and natural philosophers which was active after the 1690s. A choice matured in the years of the cultural mobilisation against the mechanistic and atomistic philosophy of the moderns and against their mathematisation of reality supported by the new techniques of analysis. It was a complex process, during which the purely geometrical approach to mathematics emerged as the "orthodox" one. "Analysis", the new infinitesimal methods deriving from the algebraic approach to geometry, was too closely linked to the "philosophy of the moderns" to be admitted in a university from where that philosophy had been banished. With the new mathematics, so suitable to "mix" with the other sciences, a philosopher could try to explain the "machine of the world" and the "human machine" without referring to other principles than corpuscles and motions. The geometrical turn of Neapolitan mathematics was grounded on the recognition that the calculus lacked a certain logical basis, that it was too empirical, and that it would have polluted the Greek ideal of pure mathematics. Neapolitan geometers, who had reached interesting results in the development of Cartesian geometry during the 1680s and 1690s, seemed unable to understand the new infinitesimal methods. "De Cristofaro", according to Palladino, "had all the technical-instrumental premises to practice the calculus, but he lacked the mentality to complete the passage from Cartesian analytical geometry to infinitesimal analysis"; he preferred to study "the pure geometry" because of its certainty, whereas the new methods are a "doubtful and uncertain" philosophical matter[23]. Doria wrote that the new methods were detrimental to geometry because they consider as geometrical lines those that are only mechanical, and in so doing they "ruin in the human mind the idea of geometrical proof, Logic, and Metaphysics". So, he hoped for a "return of Geometry to the true Logic, and to the true Metaphysics, from which it has been separated by the Moderns. And to obtain this, I want to prescribe the method of a Geometry thought in abstract, from which the Mind can deduce the Logic, to be used as a stair to ascend to the eternal Truths"[24]. It has also been argued that for Vico synthesis had an epistemological priority with respect to Cartesian analysis, because it reflects a metaphysical state of things[25]. Now, if the criticisms of philosophers such as Vico and Doria were based on a rather superficial knowledge of mathematics, and could be dismissed by as "external" to the real dynamics of the scientific debate, the reticence of a first-rank geometer such as Cristofaro is certainly in need of a more articulated explanation than that of "mentality".

Moving on to the period of the early reformism, say 1740s and 1750s, one sees that relevant figures such as Cristofaro are missing. The general level of mathematical teaching was low, particularly at the university level. One comes across obscure figures such as Agostino Ariani, who held the only mathematical chair existing in Naples between 1695 and 1720, teaching mainly Euclid. In correspondence with the independence of the kingdom (1734) and the first reformist projects, a new element entered the mathematical sciences: Newtonian philosophy of nature. Ariani himself had began to introduce in Naples the "abstruse Newtonian doctrines", i.e. themes from Newton's natural philosophy, calculus remaining extraneous to the official culture. In 1721 the chair of mathematics went to Nicola di Martino (1701-1769). He published his lectures on algebra (1725) and his lectures on mechanics (*Elements of Statics*, 1737), where the most recent results were presented and commented upon for the students. The use of infinitesimal methods ("methodus indefinite parvorum") in mechanics, as found in Newton, Leibniz, de l'Hôpital and the Bernoullis, was praised by the author. The essential concepts of Newton's dynamics were presented and discussed, even though under the mystifying cover of the scholastic terminology. He also published his lectures in plane geometry and analytic geometry (the 1737 edition is dedicated to the members of the Royal Academy of Sciences in Paris). Among his unpublished papers, a treatise on integral and differential calculus has been found[26]. His brother, Pietro di Martino (1707-1746), who had studied astronomy at the University of Bologna, was appointed to a new chair of Astronomy and Nautical Science, the second mathematical chair to be created at the RUN (1734). A third mathematical chair (Arithmetic and Algebra) was to be founded around 1761, together with the chairs of Physics and Experimental Physics. Pietro di Martino published on the *vis viva* controversy[27]; but he was mainly interested in the didactic sector. He edited the *Elements* of Euclid (1736), and wrote the *Institutions of Arithmetic* (1738), which had numerous reprints. He also published a Newtonian textbook of physics: *Philosophiae naturalis istitutiones libri tres* (1738). It was an openly anti-Cartesian and anti-corpuscularist presentation of Newton's natural philosophy, characterised by an unusual (for Neapolitan standards) stress on the mathematisation of empirical reality. But this second feature of his Newtonianism found a cold welcome in Naples, where an empiricist reading of Newton's work was being extremely successful instead, based on the interpretations offered by Algarotti and Musschenbroek. Significantly, Pietro di Martino's Newtonian textbook enjoyed a much smaller success than his Euclid. The brothers Martino, were both moved from the university to the military academies by order of the king himself. Nicola went to the Royal Academy of Artillery (*Regia Accademia di Artiglieria*), founded in 1744, and Pietro to the Royal Navy Academy (*Regia Accademia di Marina*), founded in 1735. From the 1740s onwards they published only textbooks for their new courses. The careers of both Martinos are indicative of the scientific policy of the new government: the best human and material resources were constantly diverted towards the military sector, contributing to the process of de-professionalisation of scientific teaching and research at the university. The military academies provided courses in "practical geometry" and (later on) calculus, in order to train military engineers and architects. Still, because of their specific function, they did not support any kind of advanced research. The introduction of themes from Newton's natural philosophy was then the main renewal which took place in the scientific culture of the early reformist period, the philosophical opposition to the calculus being too radical to be overcome in the passage of a few years. Things began to change for the sciences only in the second half of the century, with the teaching of Genovesi, and the emergence of Neapolitan political and economic reformism.

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1 See Baldini, "L'attività scientifica del primo Settecento", in *Storia d'Italia*, Annali 3: *Scienza e tecnica nella cultura e nella società dal Rinascimento ad oggi* (Turin: Eiunaudi, 1980) pp.469-545.

2 On Cornelio see Maurizio Torrini, *Tommaso Cornelio e la ricostruzione della scienza* (Naples: Guida, 1977).

3 Pietro Giannone, *Istoria Civile del Regno di Napoli* (Napoli: 1865) p.430.

4 Quoted in Amodeo, *Vita matematica napoletana*, vol.1, p.4.

5 Baldini, L'attività scientifica", p.486.

6 Ibidem, p.487.

7 Tommaso Cornelio, *Progymnasmata physica* (Venice: 1663). The Neapolitan edition was published in 1683.

8 Ibidem, p.488.

9 Amodeo, *Vita matematica napoletana*, vol.1, p.8.

10The University of Messina was a very particular institution in the southern panorama. Since the sixteenth century the port town of Messina was the main scientific centre of Sicily, and here worked the mathematician and astronomer Francesco Maurolico (1494-1575) and, later, thre Galileian Giovanni Borelli (1608-1679). Borelli is an exemplary case of a scientist who had to face the Counter-Reformation ideology. He taught in Messina from 1637 to 1656, and from 1667 to 1673. Politically active, he accomplished different services for the senate of Messina, and to promote the prestige of the local university, which rivalled with that of Naples. What is specific of Messina is that the ideas of the moderns blended with the strong autonomist tendencies of the enlightned aristocracy and of the the trading middle-class. The university, depending directly on the local senate, used to call prestigious teachers from other Italian states, offering unusually high wages, and became a powerful instrument in the hands of the local élites. The tensions with the Spanish rule turned into the insurrection of 1672-78. As results of the following political repression, the university was closed down in 1672, and Borelli had to flee the country.

11 Note that the case of Italy during the second half of nineteenth century is a counter-example for this kind of explanation. In that case, a country with scarce industrial development reached excellent results in pure mathematics. The disciplines which were penalized by the industrial backwardness were the ones more directly connected to technological applications, like chemistry. The success of Italian pure mathematics is indeed explained by some historians (e.g. Bottazzini), *by means* of the scarce industrial development.

12 Matteo Egizio, "De scientiarum ambiguitate. Oratio habita in Academia Unitorum Neapoli anno MDCLXXXXV", in Matteo Egizio, *Opuscoli volgari e latini* (Naples: 1751) pp.319-320.

13 Ibidem, p.322-323.

[14] Ibidem, p.321.

[15] Ibidem, p.325.

[16] Niccolò Sersale, *Introduzione all'esame delle scienze*, reprinted in Maria Donzelli, *Natura e humanitas nel giovane Vico* (Naples: 1970) p.145.

[17] *Lettere apologetiche in difesa della teologia scolastica e della filosofia peripatetica* (Naples: 1694), by the Jesuit Benedetto Aletino, where the argument is made that whoever "want to be atheist", invariably embraces the athomistic doctrine.

[18] Eugenio Garin, "Galileo e Napoli", in Fabrizio Lomonaco and Maurizio Torrini, *Galileo e Napoli*, (Naples: Guida, 1987) p.18.

[19] Particularly Giambattista Vico, *De antiquissima italorum sapientia ex linguae latinae originibus eruenda* (Naples: 1710).

[20] Paolo Mattia Doria, *Vita civile* (Augusta: 1710; orig. ed. 1709). In response to the mathematician Monforte, who exalted sciences as the higher achievement of the human intellect, Doria wrote against those who "banish philosophy from government and society, and confine it to unfruitful ravings between the stars, trying in vain to discover the occult secrets of nature" (p.2).

[21] See Garin, "Galileo e Napoli", pp.19-20.

[22] Idem

[23] "In my mind, it is impossible to find any truth in Philosophical Matters [...]. And this is why I decided to contemplate the geometrical matters, which deal with deduction of truths; and when I have tasted some philosophy, I have always preferred the one by Galileo, Borrelli and our Italians to the ones by foreigners, because I see here both the use of Archimedes and geometry and a maturity in explaining the nature of things that are lacking in Descartes" (quoted in Franco Palladino, "La geometria di Galilei e l'introduzione del calcolo a Napoli", in Lomonaco-Torrini, *Galileo e Napoli*, pp.385-398; p.393)

[24] Quoted in Palladino, "La geometria di Galilei", p.395.

[25] David Lachterman, "Vico, Doria e la geometria sintetica", *Bollettino del Centro di studi vichiani*, 1980, 10:10-35.

[26] See Luigi Pepe, "Sulla trattatistica del calcolo infinitesimale in Italia nel secolo XVIII", in Ottavio Montaldo and Laura Grugnetti (eds.), *La storia delle matematiche in Italia: atti del congresso* (Cagliari: Università di Cagliari, 1983) pp.145-228; pp.196-197.

[27] See Amodeo, *Vita matematica napoletana*, vol.1, pp.85-88.

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